NATIVE PLANTS OF DUNEDIN

And Surrounding District.

(Wm. MARTIN, B.Sc.)

PRICE - - - 2/6

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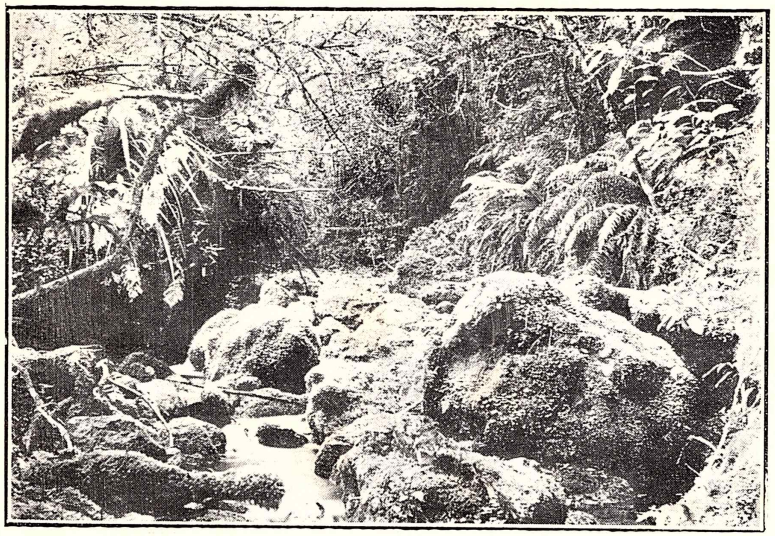
FOREWORD.

In this small volume an attempt has been made to introduce to the reader the plants which for hundreds of years held undisputed possession of our local vales and hills. Considerations of space preclude more than a line or two being devoted to any single plant, hence information as to where the survivors of this primitive vegetation may still be seen has been considered of paramount importance. A somewhat crude system of classification has also been adopted in the hope that it will prove helpful to the amateur naturalist; but scientific names have been given in each case, as without them the records would be well nigh valueless. The information herein contained is the result of three and a-half years' fairly close study of the native plants of the district, and it is hoped will prove of some service to all local lovers of our unique flora.

(Photo by S. Earland.)

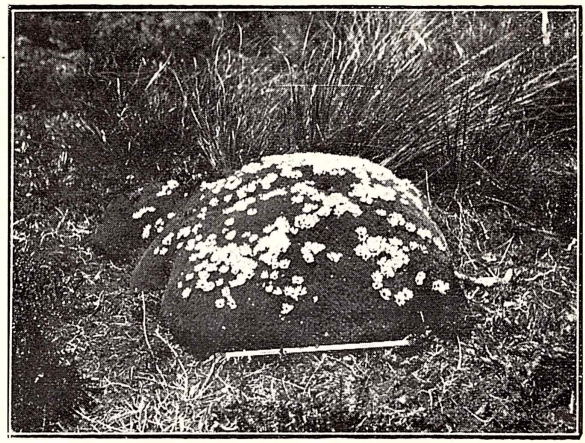
MORRISON'S CREEK,

Showing habitat of two locally rare filmy ferns—Hymenophyllum atrovirens and Trichomanes Colensoi.



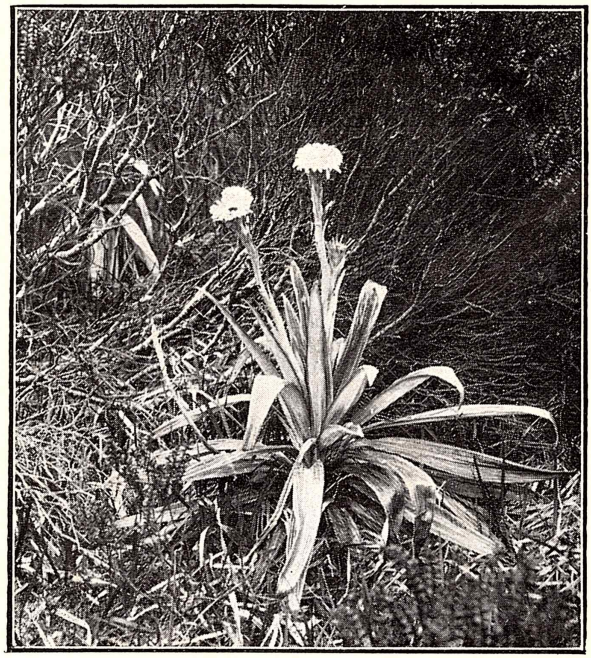
NICHOLL'S CREEK, (Photo by S. Earland.)

A well-known scenic resort.



(Photos by A. W. Bathgate.)

A Cushion of Celmisia sessiliflora on summit of Maungatua.



(Photos by A. W. Bathgate.)

Celmisia coriacea growing on the slopes of Maungatua.

NATIVE PLANTS OF DUNEDIN
AND SURROUNDING DISTRICT.

I.—INTRODUCTION.

Two years after the arrival of the pioneer settlers of Otago, Dunedin was visited by Dr Lyall, surgeon and naturalist on board H.M. Survey Ship Acheron. The collections made by him in 1850-1 round the immediate shores of Otago Harbour were the first ever secured of the plants comprising the primeval vegetation of Eastern Otago. These have been carefully preserved in the herbarium of the Edinburgh University.

Strange as it may seem, the vegetation of the West Coast Sounds was fairly well known a century before Lyall's visit. Dusky Sound had been several times visited and its vegetation studied long before the first European settlers had taken up residence in Otago. The earliest investigations were made by Dr Sparmann and the two Forsters—father and son—who in 1773 visited this locality as naturalists to Cook's second expedition. Dusky Sound in particular is famous in the botanical history of the Dominion for the number of expert botanists who in these early days collected there. Dr Anderson, of Cook's third expedition, Dr Menzies, of Vancouver's expedition, and Dr Lyall, of Stoke's expedition, in the Acheron, each in turn made collections of the native plants of Dusky or the neighbouring Sounds. The collections made by Lyall, who alone procured specimens of the eastern vegetation, were scanty in the extreme, especially in respect of the flowering plants.

During the ten years following Lyall's visit to the Otago Harbour, little further was done by way of elucidating the local flora. One or two of the pioneer settlers whose inclination or training led in that direction made considerable collections, especially of the ferns and mosses that everywhere luxuriated in the dripping primeval forests of the area. I have in my possession dried specimens of mosses collected by my grandfather—the late Mr Wm. Martin, of Fairfield—on Mount Cargill and at Anderson's Bay, bearing the date 1851. Many other specimens bear dates between 1851 and 1860. Stern necessity, however, gave little respite for collecting, and still less for the determination of the species obtained.

Such, then, was the state of Dunedin botany when, in 1861, Dr Lauder Lindsay, a noted cryptogamic botanist, arrived, and set himself the task of unravelling the many unsolved botanical and geological problems of Eastern Otago. The duration of his stay scarcely exceeded three months, during which time his headquarters were my late home at Fairfield. Referring to his activities in a work he subsequently published, he says, inter alia:—

> From this centre (Fairfield) I made frequent foot excursions in every direction. The area botanically examined includes Dunedin and its vicinage; the Green Island district, with its coast and hills; the Saddle Hill district; the Chain Hills Ranges; and part of the East Taieri Plain.
>
> The whole area explored may be said to constitute a parallelogram of the East Coast Belt of Otago—about 60 miles long by an average of five, and maximum of 35 broad; bounded on the north by Mount Cargill, Dunedin; on the south by the Clutha and the Nuggets; on the west by the Tuapeka Ranges; on the east by the East Coast; in superficial area equal to less than one-eightieth of the whole province.
>
> My collections were made within a limited period. My residence in Otago extended from October 7, 1861, to January 20, 1862. But during only a portion of this period was it in my power to collect plants; nor was systematic botanical research or collection compatible with the main object I had in visiting Otago. I could devote only a certain portion of my time to botanical work which was thus perfunctory, fragmentary, and superficial.

Considering the shortness of Dr Lindsay's visit and the multiplicity of his interests and activities, it is surely a monument to his industry and skill that he should have collected no fewer than 612 species of plants, including 50 which were quite new to science. Included in this large number were some 200 flowering plants and 149 lichens. Notwithstanding this fine achievement, Dr Lindsay states that his investigations were mainly geological, and it is only fair to say that his results in this latter domain were not less important than were his botanical researches.

In the years immediately following, as also in the years that preceded Lauder Lindsay's visit, the outstanding worker on the flora of Otago was Mr John Buchanan, botanist to the Geological Survey of the Provincial Government. It was he who first made known the wonderful alpine flora of Otago, while he contributed in no small degree to our knowledge of the plants com-

prising the florula of the Dunedin area. His herbarium is now lodged in the Otago Museum.

In 1871 the Dunedin Naturalists' Field Club was established, and in subsequent years almost all who have contributed materially to the study of the plants of the district have been included in its membership. Of the many who have assisted in compiling a catalogue of the local plants two names stand out conspicuously—Dr D. Petrie, M.A., formerly inspector of schools for Otago, but now resident in Auckland, and the Hon. G. M. Thomson, F.L.S., who is still giving his time and unflagging energy to the welfare of our fair city. Dr Petrie to-day shares with Dr Cockayne the foremost place among the botanists of the dominion, and I take the opportunity here of saying that many facts mentioned in the following chapters are the observations of Dr Petrie, who has placed his intimate knowledge of the plants of the district at my disposal. The Hon. G. M. Thomson was a foundation member of the Field Club, and is still its leading member. His delightful little book, "A Naturalist's Calendar," should be in the hands of every lover of Nature in Dunedin, and it will long remain the best essay on the fauna and flora of Dunedin.

In 1891 Dr S. Berggren, a Swedish botanist, in two days' collecting on Flagstaff and in the Leith Valley, was fortunate enough to secure quite a number of new species amongst the cryptogamic plants.

Mr W. Bell, of Pine Hill, was also an ardent collector of the local mosses, and many of his "finds" were quite new to science. Mr S. L. Fulton, Mr H. J. Matthews, and Mr A. Purdie were other enthusiastic students and collectors, and each was the discoverer of plants not known formerly to grow in the neighbourhood. Mr H. J. Matthews formed quite an extensive herbarium, which to-day lies in the dismal vaults of a local public office, but his collections of rare and local native plants now in the possession of Dr Hunter and carefully tended by Mr M'Intyre, are among the best extant. In Mr Alex. Bathgate, Dunedin has always had a keen student of all branches of Nature, as is amply attested by his recently published paper on the changes in the Natural History of Dunedin in the past fifty years. My grandfather—Mr W. Martin, sen., of Fairfield—was still another whose collections, both living and dried, represented the work of over half a century. These collections were much enlarged by my father, who was also a keen and close observer.

Many of the keenest students of Nature who have been resident in this district have been active members of the Dunedin Naturalists' Field Club. First and foremost of these is, as I have already stated, the Hon. G. M. Thomson, but others who have added greatly to our knowledge of the local flora have been Dr D. Petrie, Mr P. Thompson, Mr S. L. Fulton, Professor J. S. Tennant, Mr R. M. Laing, Mr J. Crosby Smith, Mr B. C. Aston, Mr W. A. Scarfe, Mr J. W. Williams, Miss M. Finlayson, and Miss H. K. Dalrymple.

Messrs. R. M. Laing, J. Crosby Smith and W. Scarfe have an unrivalled knowledge of the local seaweeds, as Miss Dalrymple now has of the local fungi, which she is assiduously collecting and cataloguing. Among the flowering plants, Mr B. C. Aston, in particular, has many new finds to his credit. Very interesting articles have from time to time been published in the Otago Witness and the local press by various writers, those of Mr G. M. Thomson and Mr A. Reynolds (of Macandrew's Bay) being specially praiseworthy, while the fortnightly accounts of the activities of the Field Club have done much to popularise the study of local natural history. Summaries of the local flora were written for the handbooks of the Australasian Association for the Advancement of Science meetings at Dunedin (1904) and Wellington (1922) by Hon. G. M. Thomson and myself respectively.

If in this brief account I have omitted the names of any whose work deserves recognition I wish to tender sincere apologies for what they may rest assured was an unintentional omission.

SALIENT FEATURES OF THE VEGETATION.

Few towns in the world are possessed of such a wealth and variety of plants as Dunedin and its immediate vicinity. In part this results from a great variety of habitats ranging as they do from sea-level to an altitude of 3000ft. There are sand dunes and mud flats, brackish marshes and fresh water lagoons, peat bogs, swamps and streams; there are tracts of forest and areas of sub-alpine herbs, dry hillsides and damp valleys; there are volcanic rocks, sandstones, mudstones and schist. Each of these various and varied stations is reflected in the character of the vegetation, hence the botanical complex that results has few rivals for areas of similar size in any quarter of the globe, save, perhaps, in the tropics. This may be judged from the following summary.

The area under discussion may be said to extend from Otago Heads to Maungatua and thence by the Taieri River to the sea. In this area there are over 500 native land plants, besides approximately 200 introduced plants that have become naturalised in whole or in part. These figures are exclusive of the hundreds of mosses, fungi, lichens, and liverworts that are still to be gathered in the area and of the 150 seaweeds that grow between tide marks or below.

The bush contains 39 trees, while of shrubs we possess 71, and of herbaceous plants 350. Of ferns there are 75, of native grasses 45, and of sedges 45. There are 19 climbers and 5 mistletoes.

When one reflects that fully 90 per cent. of all this amazing wealth of species is still to be met with within the bounds of the visible horizon as viewed from the heart of the city, it will be seen that Dunedin students of this branch of natural history have no lack of material for study.

It is a matter for great satisfaction that so few of our native plants have been exterminated in the area, the number not exceeding five or six. From time to time statements have appeared in print lamenting the loss of this plant or that, but while it may have disappeared from some particular spot, it has usually turned up in another, and not infrequently it has been rediscovered on the very spot where it formerly grew. As reference to many of these will be made in the course of the following chapters, more need not now be said about them.

In the area with which we are more immediately concerned it can safely be said that there are more than 1500 distinct species of plants exclusive of such as are only of microscopic size and of such as grow only in our gardens. Dunedin is a veritable natural history museum, for not alone in the realms of the botanist is this complexity and variety seen. The geology of the district has never been worked out in detail, though its salient features are fairly well understood, thanks largely to the work of Professors Marshall, Park, and Benson, and their students.

The insect fauna is very rich in species if not in actual numbers of insects. Between 80 and 90 species of beetle, and several hundreds of moths, have been collected round the immediate environs of the city. Other orders of the insects are probably represented proportionately. Native birds are no longer so plentiful as they formerly were, and many once common have disappeared—as, for instance, the native quail, the crow, the kaka, the parroquets, the saddleback, native canary, fernbird, weka, and kiwi. Others, which, still met with occasionally, are less common than formerly include the tui, bittern, pukaki, etc. In view of these facts, it is surprising that many more persons do not seek that delightful relaxation from the mercenary cares and business worries of the week that is associated with the study of these various phases of natural history. The frequent walks over hill and vale inseparable from the study of natural history afford exercise of the most health-giving type. Nor is a university training a prerequisite. Indeed, it is open to question whether the methods of many of the schools and the universities do not only too frequently stifle rather than foster the inherent love of nature born in every one of us.

Armed with the Field Club's catalogue of the plants of the district, and possibly with the notes in the following chapters, little difficulty should be experienced in acquiring more than a passing acquaintance with at least a quarter of the native plants of the Dominion.

II.—HOW THE PLANTS SPEAK.

Every feature in the structure of a plant bears the impress of the environment in which it has evolved and developed. By studying the nature of the response made by plants to various and varying stimuli, some knowledge can be gained of the conditions under which in far-distant ages they have acquired their present characters. Every plant is, as it were, a historian, revealing to discerning eyes the more or less complete story, not only of its own existence, but also of the race to which it belongs. A great part of the pleasure to be derived from forming the acquaintance of our plants lies in one's ability to understand in some measure the language in which they speak to us. Hence it will not be irrelevant if we devote this chapter to such a study, brief and casual as it must necessarily be.

The story of a plant is essentially similar to that of a human individual or family. It tells of ancestry, relationships, and heredity; of birth and upbringing; of marriage and romance; of adaptation to environment; of sickness and disease; of failure and of conquest; of famine and of pestilence; of animosities and friendships. Now, just as two historians may tell the same story by the use of entirely different words or symbols, so two plants may tell of similar experiences through the medium of wholly dissimilar features. Otherwise expressed, the same stimulus that brings about a reduction in the size of the leaf in one plant may develop a thick coating of hair on another or a covering of wax in a third, or thick mucilaginous sap in a fourth. Hence it comes about that the student can often discern a common history in an association of plants of vastly dissimilar aspect.

It is common knowledge that individual plants, like individual races of mankind, can thrive in localities where others would starve. One would not expect the polar bear to thrive in Central Africa, or the alligator in Lapland. Similarly, every plant has certain minimum requirements, and is unable to thrive in stations where any one of the essential conditions is lacking. Nevertheless the plant has a certain power of adaptation and will remodel its form and habits to a certain extent in order to accommodate itself to circumstances, and it

is largely owing to this plasticity that we have the amazing variety of plant forms met with to-day. Flowers are influenced only slightly by environment, but all other parts of the plant show much greater response. There are certain requirements common to all plants of which a requisite supply of moisture, food, light, warmth, and air is chief. Any slight deficiency in any of these, or any inhibitory feature, will immediately lead to a structural change in the plant. Thus, from a study of plant forms we can in part reason backwards to the causes of their production.

Of all the needs of the plant none is more potent in influencing growth than is that of the available water supply. Thus a continued shortage tends to induce the formation of increased root systems, reduced or modified leaf surface, water storing tissue, or other devices for conserving moisture. Increased intensity of light produces a dwarfing effect known as nanism. Reduced intensity causes a response in the form of greatly enlarged leaves and greatly elongated stems. Thus in Samolus and Selliera two of the commonest plants of our seashores, the leaves shaded by the rushes may be 10 to 12 times as large as those on the same plant fully exposed to the sun. Again, shrubs such as the Coprosma or the Melicope, growing in the shade of the forest may have leaves very much larger than those fringing the bush or out in the open. Indeed, it often happens that the leaves in the interior of a shrubby plant are several times larger than those at the outside. Shade also causes stems to lengthen, and is usually the first factor in inducing the climbing habit in plants. Salt in the ground causes succulence. Strong insolation induces the tussock form in which the leaves lie more or less end on to the incident rays of light. The influence of wind produces a very marked effect on vegetation, tending to dwarf trees and shrubs, and inducing the growth of such plants as have small or leathery leaves capable of withstanding the fury of the storm. A perpetually dry habitat is usually peopled by plants many of which are very hairy or spiny, whereas these characteristics are scarce in wet situations. The form of the plant is clearly a function of the habitat.

Every organism tends to produce its like and it seems evident that after a sufficient lapse of time characters may be acquired by the plant. The large-leaved plants peopling an exposed situation would either die out or become modified by the production of greatly reduced leaves. We have local examples of this in the makomako or wineberry (Aristotelia) The lowland species (A. racemosa), growing mostly in forest, has large thin leaves; the subalpine species (A. fruticosa), growing on Swampy Hill, has tiny leaves and a zigzag type of branching well calculated to give added resistance to the destructive effect of wind. Again, the large leaved tutu (Coriaria) of the lowland is replaced on Swampy Hill by two other species with very small leaves, one species indeed having leaves that are only a small fraction of an inch in area. Similarly, the lowland bush forms of Panax have larger leaves than the upland forms.

In this connection may be cited a number of trees which have a wholly dissimilar appearance according as they are young or mature The kowhai (Sophora), kaikomako (Pennantia), milktree (Paratrophis), lacebark (Plagianthus), and pokako (Elaeocarpus), will be found to have small leaves and divaricating branches when young, but larger leaves and straight branches when old. This is merely a good example of the well-known law that individual plants or animals in their own development recapitulate the history of the race of which they are members.

During an epoch of intense cold, when New Zealand was of continental dimensions, and the land surface was greatly elevated, these plants adapted themselves to their rigorous environment by decreasing their transpiration surface; but on the depression of the land and the return of milder conditions they have been enabled to restore the larger leaf surface they formerly possessed. Each individual recapitulates these racial changes. Such, indeed, is the accepted explanation of to-day.

The point that stands out clearly is the fact that every feature of the plant has a meaning which is capable of interpretation by the student of nature. Clearly it tells the story of its ancestors as well as the facts of its own existence. Nothing so quickly or so greatly influences the growth and form of a plant as the variations in the available water supply. I say "available" advisedly, for a plant may grow in water and perish of thirst. This is one of the first lessons the amateur ecologist must learn. The mere existence of water is one thing, but whether or not it is available is a very different thing.

Let us recall how a plant absorbs moisture. With the exception of the filmy ferns—Hymenophyllum, etc.—and the mosses and liverworts, plants as a rule absorb water through their roots by a process termed osmosis. Whether the moisture present in the soil will enter the root-hairs or not depends upon several things. If the water has in solution a large amount of saline substances, or of acids, or if the water be very cold, then osmosis is reduced or checked, and the loss of water by evaporation from the leaves is not replenished by the absorption at the roots. In consequence the plant wilts, and, if the evil is not speedily remedied, the plant slowly but surely dies. Thus rushes growing in swamps require often the same protection against

drought as when growing on dry clay banks or on sandhills. Whenever an area remains physically dry for lengthy periods, the vegetation will reveal an array of adaptations against dessication; and the existence of similar plants or similar adaptations in plants peopling a moister area may be regarded as an indication that either the ground is very cold, as—e.g., in subalpine regions, or very sour as in swamps, or very saline as round brackish lagoons and bordering the seashore. Osmosis is checked also by high temperatures, hence the presence round hot springs of plants elsewhere most abundant in swamps or on the seashore. It is only when viewed in this light that the vegetation of any district acquires a real meaning.

Realising that places physically wet may be physiologically dry, we are enabled for instance to account for the clubrush (Cladium) and common rush (Juncus effusus) occurring both on the marshes of Hooper's Inlet and on the dry slopes of Flagstaff; for such a sand-frequenting species as Claytonia being found in alpine districts as well as on sand dunes; for the bush flax (Astelia) occurring on the seacoasts, on rocks, on tree trunks, and in thermal areas and swamps as happens with at least one North Island species (Astelia Cunninghamii). Realising that modifications are called into existence, let us note their nature. The general principle of drought resistance is that either the power to absorb should be increased in proportion to the dryness of the area or that the power to transpire should be reduced similarly, or as more frequently happens both should occur simultaneously. Secondary characters of importance are the development of a tussock habit where the dead interior makes humus to conserve moisture for the living perimeter; or the development of mucilaginous sap, or of "profile lie"; or, it may be, the plant develops water-storing tissue as with the flax (Phormium), or ice-plant (Mesembryanthemum) or native spinach (Tetragonia), etc., As a means of increasing the of absorption, sand plants and plants in a great variety of xerophytic stations will often be found to develop a root system far in excess of the normal. But it is in leaf modification that the greatest variety of adaptations is met with. Thus the following leaf features all serve a similar end, the plants having modified their parts along a different plan with the same benefit in each case.

Leaf surface may be reduced as we have already indicated, but in many cases the leaves are reduced to scales—e.g., the Cape Saunders rock daisy (Helichrysum selago), or the jointed rush (Leptocarpus) of brackish lagoons; or they may be wholly absent as in the celery pine (Phyllocladus) of Mount Cargill or the leafless lawyer (Rubus cissoides var. pauperatus). By crowding the leaves one against another there has developed a form seen to perfection in the mountain sheep, as well as in numerous other cushion plants, such as are well represented on the summit of Maungatua. Again the stomata may be sunk in grooves so that on the coiling of the leaf in hot sunshine no evaporation from that source can take place. This occurs for instance in the marram grass of the sandhills. Again the coiling of the leaves in many of our tussocks serves a similar end, for in most grasses the stomata are on the upper surface. When wind is blowing, or the sun is shining brightly the leaves remain coiled, but open on the advent of moist weather. Crinkled leaves—(Matipo and native holly), thickening of the epidermis (Shore-spleenwort), a covering felt of hairs (Silver-weed), sunken stomata (native broom), a coating of wax (fathen), and numerous other devices are adopted to achieve the same end. A few plants are leafless at one season and leafy at another —i.e., deciduous, as, for instance, the lacebark, fuchsia, and frequently the kowhai. The leaves of deciduous plants are as a rule thin and transpire water continuously so when the cold of winter checks osmosis the tree casts its leaves for sheer preservation. A few plants die down in winter to achieve the same end. They, as a rule, have swollen rhizomes as in the brackens and Hypotepis among ferns, or a swollen bulb as in the case of the numerous ground orchids. In any community of plants it is customory to find one form dominant even in plants genetically very far apart, with a sprinkling of other forms interspersed. These plant forms may be considered as a true reflex of a particular local combination of conditions, climatic and edaphic, and occur in all parts of the earth where the same set of conditions exists. Thus, on the saline mudflats succulence is characteristic; in subalpine districts, the shrub form; and if the area is wind swept the divaricating (zigzag) shrub form will be found dominant; in dry alpine localities the tussock-grass form is typical, while the cushion form is dominant in alpine peat bogs. Again the rush-form of swamp plants, and the heath form of dry, barren clay soils are further examples. Where conditions change rapidly from place to place a distinct zonation of the vegetation is usually in evidence. Nowhere is this better seen than on brackish swamps where the glasswort (Salicornia) of the first zone quickly gives place to the jointed rush (Leptocarpus), and this in turn to various other plants. The same zonation is in evidence where altitude changes rapidly: First, the shore vegetation, then the forest, then the sub-alpine shrubland, and then the alpine herbfields. In still another form the same law is seen in operation where

certain plants are typical of certain stations. The stream courses flanked with rushes, the damp lands studded with buttercups, the sand dunes covered with marram grass, or the native pingao, and the coastal cliffs with the shore spleenwort (Asplenium obtusatum) are sufficient instances to illustrate the point. Spininess is confined to plants in dry stations (usually physically dry). The only really spiny plants of the district are the two Spaniards (Aciphylla), the matagouri and the Hymenanthera, but the tendency to spininess is clearly seen in at least three plants of the subalpine portion of the district—viz., mingi-mingi (Coprosma propinqua and C. parviflora?) and the drooping mapau (Suttonia divaricata). Rosette plants are most frequent in wind swept or alpine stations, and the advantages of this form are both real and obvious. Lastly, students of variation will find scope and plenty of material for testing the various theories that are in vogue. A problem that still remains unsolved is the cause that has brought into being so many plants that have the anthers on one plant and the carpels on another. Familiar examples of such plants are the various species of clematis, "lawyer," pine, and coprosma. Altogether there are in the district a large number of unisexual plants, while numerous others are incapable of self-fertilisation because the pollen grains do not ripen simultaneously with the pistil.

III. THE PLANTS OF THE SEA COAST.

THE SAND DUNES.

Plants capable of establishing themselves on loose drifting sand though few in number, are characteristic in form. Not only is drainage here excessive, but the sand is usually coated with salt derived from the sea spray, making it still more difficult for plants to absorb what water would otherwise be available. It thus happens that the first and prime requisite of a dune plant is that it be a drought-resister of a pronounced type.

Wherever such pioneers are found, they have two things in common—first, long, branching rhizomes or runners giving off at intervals shoots and numerous very long roots; and, secondly, ability to resist burial by the drifting sand. Of course, when a dune has finally been stabilised by such plants, others are not long in finding a footing.

As a sand binder no plant surpasses the well-known marram grass, which is now almost as common on the sand dunes and sand drifts of New Zealand as on those of its native European home; but on the whole of the dunes in this district a native sedge or cutty-grass—the pingao (Scirpus frondosus)—will be found scarcely less common or efficient. Its long, rope-like stems traverse the sand in all directions in the orthodox way, and each gives off so many long, downward-penetrating roots that the movement of the sand is almost stopped. These two plants are invariably the first colonists of our local sand dunes.

On somewhat more consolidated sand the lupin is very effective in arresting this movement, and is of great use as a sand-binder, as witness the lupin-covered sands at the Kaik, Ocean Beach, and Brighton. The beautiful pink-and-white shore convolvulus (Calystegia soldanella), so abundant at this last locality, performs the same function in similar places. Somewhat less common dune plants are the sand-sedge (Carex pumila), met with at Kaikorai Mouth, Brighton, and Bruce's Rocks, and the silver pimelia (Pimelia arenaria), commonest between Brighton and the mouth of the Kaikorai. The former is a grass-like plant with stout runners, and the latter a handsome silvery little shrub which from October onwards bears an abundance of small white flowers.

Between Brighton and Taieri Mouth and near Kaikai Beach, another native sand-loving plant, the milkweed (Euphorbia glauca), is not uncommon, and can scarcely be mistaken by reason of its long, upright, unbranched stems, 2ft to 4ft in length, its glaucous, blue leaves, and milk-white sap. Still another plant specially abundant south of the Kaikorai, though nowhere uncommon, is the sand coprosma (Coprosma acerosa). The zig-zag stems, narrow leaves pressed close to the stem, and the abundant pale, translucent blue berries in season distinguish this little shrub from all other plants of the seacoast, where alone it is to be found. A similar plant, not uncommon at Flagstaff, Look-out Point, Abbotsford, and at the foot of Saddle Hill, has long been mistaken for this sand-loving species, but, though similar, it is quite distinct. On loose sand at and near Brighton there occurs a small quantity of a native fescue, and this about completes the list of occupants so far as the wholly or partially unfixed dunes are concerned.

Immediately to landwards will be found a considerable array of new plants, and all displaying in greater or less degree the features designed to increase absorption of water on the one hand or reduce the transpiration of water from their leaves on the other.

Here, then, may be found flax, toi-toi, bracken, fireweed (Erechtites), native box (Cassinia fulvida), and wherever the sand has been sufficiently fixed and compacted bidibidi, dwarf heath (Styphelia Fraseri), tutu, bramble, and bullibulli (Solanum aviculare). A mat-plant (Raoulia Monroi),

with its tiny folded leaves in two opposite rows is quite common, as are a round-leaved trailing Hydrocotyle, and the bright little star-flowered Claytonia. This latter plant is never plentiful, though it is widely distributed

Where turf has formed on the surface of the sand one meets in addition to many of those already mentioned a little geranium (G. sessiliflorum), with hairy leaves about the size of a threepenny piece, several species of bidibidi (two with bright red spines), tussock (Poa caespitosa), and the native burnet (Potentilla anserina), a creeping member of the rose family with yellow flowers not unlike those of a buttercup, and bronze-coloured pinnate leaves. A native plantain or ribgrass (Plantago Raoulii) is not uncommon, while several grasses and sedges occur. In October a white violet throws up its dainty little flowers revealing its hitherto unsuspected presence.

It frequently happens that large hollows in the dunes reach down to the underlying soil or near to it, and a special vegetation may sometimes be found there, especially if water collects and escapes but slowly. Thus in a large dune hollow on the north side of the Kaikorai, between the mouth and the bridge, there occurs abundance of the introduced centaury (Erythræa centaurea), a plant of the gentian family bearing either white or pink blossoms, a plantain, a comparatively rare cousin of the veronica (Gratiola peruviana), and two pennyworts (Hydrocotyle americana and the tiny-leaved H. tripartita, var. minima), all of which are met with on the sand flats at Wickliffe Bay.

In another dune hollow half a mile or so north of the Brighton Creamery, and known to some people as the "Maori grave," there used to grow two diminutive and interesting plants—Crantzia lineata, elsewhere in the district reported only from Tomahawk Lagoon; and Limosella tenuifolia, another cousin of the koromiko. The long-continued submergence of this hollow, following on the severe floods of last winter, has caused the temporary disappearance of both these plants. In a third hollow, close to the entrance to Papanui Inlet, a native species of forget-me-not (Myosotis antarctica) is the sole occupant The plants are here bigger than I have seen anywhere else, being twenty times the size of the same plant growing on the summit of Sandymount, where the sand crosses the ridge. These are the only places where I have seen this plant in the Dunedin district, though it used to grow on Lawyer's Head, Forbury, and Black Head.

PLANTS OF THE SAND-FLATS.

The coast-line of Otago Peninsula has reached that mature stage of dissection in which precipitous cliffs and abrupt headlands alternate with sandy beaches and tidal inlets. Across each inlet a sandspit based upon the northern side has formed, most of which has been stabilised and completely clothed with grass and other vegetation. Between these fixed areas of non-moving sand and the movable and moving sand dunes great differences exist in respect to the conditions that promote or inhibit the growth of plants, with the consequence that a varied and abundant vegetation covers the surface. Nevertheless, it is often difficult to draw a clear line of demarcation between the two areas.

Most of the plants of the dune-hollows already referred to belong rather to the sand flats and salt marshes than to the dunes, but it was convenient to visit them while inspecting the more characteristic dune plants. The largest sand-flats in the district are those at the entrance to the harbour, Wickliffe Bay, Hooper's Inlet, and Kaikorai Mouth, but many smaller patches are met with at intervals between these and in the direction of Taieri Mouth.

The dominant vegetation of these areas consists mainly of grasses, rushes, and sedges, but, as we propose to consider these separately later on, we shall pass on to examine such other plants as may there be met with.

Here various species of bidibidi (Acaena) occupy considerable tracts. The commonest species of all is too well known and cursed to warrant more than mention, but its relative (Acaena novae-zealandiae) is a much more attractive plant. Each flower produces four long bright red spines, but very many flowers are clustered together into a single head which therefore stands at the centre of a vast array of bristles with a spread of over an inch. A patch of this plant in the fruiting season makes a brilliant show, while the fruits do not adhere so tenaciously as do those of the commoner type. It is to be seen at Wickliffe Bay and near the north end of the spit at Hooper's Inlet, but it is equally common in parts of Whare Flat—e.g., near the school. A third species has much smaller leaves and almost barbless spines—a form of A. microphylla. It frequently has bright red spines also, and is quite attractive in appearance. This form is common on the three main sand spits, but a great amount of variation is noticeable, and it may be that several named varieties are included in the series. Variety depressa of this species certainly occurs (for instance, at Brighton), as well as the typical form.

The little heath (Styphelia Fraseri) is always common, and the creeping Dichondra, a diminutive relative of the convolvulus, is a frequent associate, as also are two species of cudweed (Gnaphalium luteo-album and G. collinum). A buttercup (Ranunculus multiscapus) is usually present where the ground tends to dampness, but another species (R. rivularis) replaces it on still wetter land.

A particularly interesting locality is the portion of the sand spit at Hooper's Inlet between the road and the clump of manuka, where swamp conditions prevail and sphagnum moss flourishes. Here may be found the Drosera binata or fly catcher, one of two species of sundew that occur near Dunedin. This plant has its leaves covered with glandular hairs which secrete a sticky fluid to trap insects that may chance to alight upon them. But this fluid has the further quality of acting upon the insect as do the digestive juices in the stomach of some animal and then of absorbing the fly "in solution," leaving only the empty skeleton.

Between this clump of manuka and the water of the Inlet there may be found a very interesting plantain known to science as Plantago trigyna, which has but a single capsule on each flower stalk in place of the numerous capsules of the more common species of our fields and gardens. A few plants of this native species may still be gathered near the head of Tomahawk Lagoon on the west side, or in a dune hollow close to Kaikorai Mouth, but it is much more common on the Sandymount ridge, where the forget-me-not already referred to grows. This plant has been recorded till recently as Plantago uniflora, a plant of the Ruahine ranges that eluded capture for close on half a century after its initial discovery by Bishop Colenso.

In moist hollows on Wickliffe Bay flats Mr B. C. Aston found a number of interesting plants which had previously eluded other searchers, these including Elatine americana var. australiensis, a little plant with a very big name; Hydrocotyle tripartita var. hydrophila, an even smaller plant with a name no less big; Gratiola peruviana, already mentioned; Glossostigma elatinoides; and Veronica canescens, the smallest native speedwell. This last plant usually grows on mud or fine shingle, which it resembles in the colour of leaf, but owing to its very diminutive size it is scarcely possible to notice it unless it be in flower. The flowers are produced singly on the stems, but, being of a conspicuous blue, the plant can now be easily detected. It flowers in February. On this same flat the writer was fortunate enough to discover a species of buttercup (R. recens), for which no Otago habitat was previously known, though some time previously I had also found it plentifully on Sandymount. Cheeseman, in his "Flora" records it elsewhere only from Hawera in Taranaki and Fortrose in Southland. The flowers open in November, but have little or no stem, and, being greenish yellow in colour, are by no means so pleasing as are its artistic leaf rosettes.

As is usual in almost all dry areas, the little thread-stemmed daisy (Helichrysum filicaule) is common in company with several other plants frequently associated with it, as the grass-leaved Celmisia (C. longifolia), a geranium, a creeping willowherb (Epilobium nummularifolium), the white violet (Viola Cunninghamii), and Fraser's heath (Styphelia Fraseri).

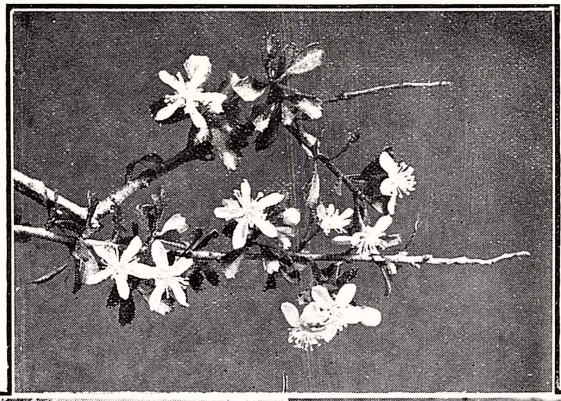
Few shrubs other than coprosmas grow on the Spit at the entrance to the harbour, and few besides manuka at Hooper's Inlet. A few stunted trees and shrubs occupy sheltered hollows at Papanui Inlet.

TIDAL MUD FLATS.

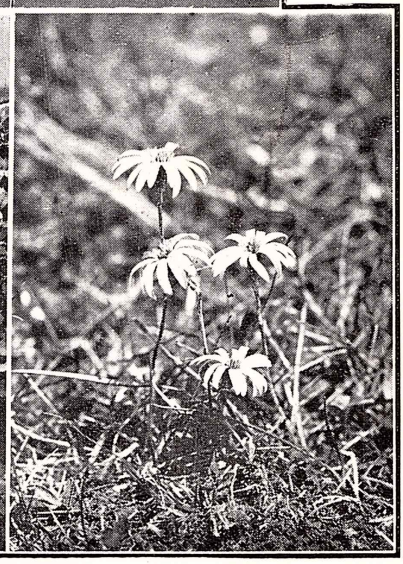
From one end of New Zealand to the other there is a remarkable sameness in the species of plants that inhabit the low, flat, saline, muddy ground bordering so many of our shallow, tidal inlets. Such salt marshes are well represented at Hooper's Inlet, Papanui Inlet, Tomahawk, Kaikorai Swamp, and Otago Heads, while in earlier days much of South Dunedin and Tainui carried a similar vegetation. In such localities as these the main barrier to plant colonisation is high salt content and poor aeration of the soil with all its consequences. In the presence of excess of salt the power to absorb moisture is inhibited. Hence plants might actually die of thirst while growing in the water—"Water, water everywhere but not a drop to drink." It will not, therefore, be strange if we meet here also with a vegetation showing marked drought-resisting features. In fact, all the inhabitants of this zone do possess these very features. Thus there are many which store up water in their tissues as occasion offers and so become succulent—such as the leafless, round-stemmed Glasswort (Salicornia) and the yellow flowering bachelor's button (Cotula coronopifolia). The rush form is adopted by numerous rushes and sedges probably because round stems and leaves have relatively less transpiring surface than flat stems. Many of these plants are leafless, or else the leaves are reduced to scales, as in the jointed rush (Leptocarpus simplex).

The varying degrees of tolerance for salt and for partial immersion by salt water are well reflected in the zonal arrangement of the different species of plants to be found in these places. Standing in the salt water, the first plant encountered will usually be the green triangular stemmed sedge with a brownish flower head close to the tip (Scirpus americanus), or the sea-sedge. Growing on the landward side of this, the jointed rush (Leptocarpus simplex) will usually be found. This plant, which was much used by the Maoris, who thatched their houses with it and carpeted their floors, has wiry, often bright red, stems with black scales at every few inches, making its identification simple. Two profusely flowering prostrate, creeping herbs of almost universal occurrence in the next zone—the sea prim-

Hoheria augustifolia (Houhere).



Clematis indivisa (Puawananga).

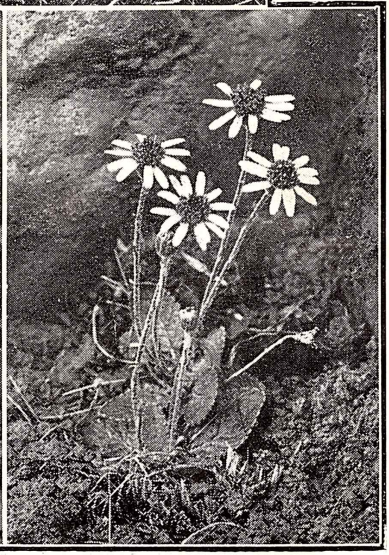


Celmisia longifolia.

(Photos by W. Davidson.)

Styphelia Frazeri (Pa-totara).

Olearia arborescens
(Chinese Musk).



Senecio bellidioides.

(Photos by W. Davidson.)

rose (Samolus repens), and the somewhat similar (Selliera radicans)—are sure to be met with. Equally common is the sea parsley (Apium filiforme) growing amongst the rushes or depending from low mud banks. More common still is the jointed stemmed glasswort (Salicornia), which frequently advances well on to the part of the mud flat covered at high tide. Associated with it, but usually of rarer occurrence is the equally succulent sea purslane (Suœda maritima), common on the northern shore of Hooper's Inlet and elsewhere.

On land, above ordinary high tide mark, numerous other plants find a place of residence free from the competition which elsewhere would speedily lead to their extinction. Triglochin has leaves like those of early spring onions; various species of native fathen (Chenopodium) and its near relatives (Rhagodia and Atriplex) may best be recognised by their mealy leaves and the general resemblance to their garden relatives; while the bachelor's button (Cotula coronopifolia) on account of the profusion of bright yellow buttonlike heads, can hardly be mistaken.

A very pretty plant which frequently lives in company with these plants though always in smaller numbers is the purple-flowered musk (Mimulus repens). Close to the gate giving access to the track leading from the road to the clump of manuka on the sandspit of Hooper's Inlet, this attractive little plant will be found more abundant than elsewhere in the district. It may be found round the Kaikorai swamp and near the outlet of Tomahawk Lagoon.

New plants are met with as soon as a zone is reached beyond the area subject to inundation. First, we find as a rule a number of rushes and sedges, but just what plants will appear in the succeeding zones will depend on a variety of circumstances of which the nature of the substratum is chief.

THE COASTAL ROCKS AND CLIFFS.

For convenience, we apply the term "cliff" to all banks and more or less vertical slopes that border the seacoast, whether they be but a few feet in height or several hundreds of feet. On these cliffs will be found an assemblage of plants not to be met with elsewhere. Individual plants may, of course, be included among these which are equally common on the lagoon margins, sandhills, and sea beaches, but others again are wholly confined to these cliffs.

In all parts of the world it will be found that plants growing in a saline soil acquire unusual succulence of leaf and stem. Hence the plants of the cliff faces display this feature equally with those of the saline mud flats of our tidal inlets.

First and most conspicuous of these rock dwellers is the ice-plant (Mesembryanthemum australe). An introduced plant of the same genus, with very large yellow flowers (M. edule), is common along the lower Portobello road, but the native species has much smaller leaves and rose-coloured flowers, which open only in bright sunshine, a fact which is suggested by the name. A white variety is reported by Mr H. Christie as growing on the cliffs north of Cape Saunders. The larger plant is the well-known Hottentot fig of South Africa. A first cousin of this fig-marigold, as it is also called, is the New Zealand spinach (Tetragonia trigyna). This succulent may be found in sheltered places not only on the cliffs but anywhere in their near neighbourhood. It has a trailing and even a climbing habit. At the heads of Tomahawk Lagoon and of Hooper's Inlet I have noted specimens with stems upwards of 40ft in length and a couple of inches through. In such cases the foliage grows only near the tips of the branches, which sprawl over the tops of neighbouring shrubs. The flowers are small and yellow, but the fruits are red and are filled with a red juice that has been used as a substitute for ink. On the most exposed rock ledges it is not uncommon to find the round succulent-stemmed glasswort (Salicornia), which we previously noted on our tidal mud flats. Not uncommonly, the smaller but equally succulent Tillaea moschata will be met with. It grows for example near the entrance of the Tunnel Beach and on the rocks at Black Head. A much more uncommon plant, which is now most easily found on the coastal rocks at Sandymount and Cape Saunders is the reddish succulent sea-chickweed (Spergularia media). This plant has cylindrical leaves, usually less than one inch long, and white stellate blossoms.

Even more uncommon now, though once plentiful enough before stock gained access to these coastal cliff faces, is the seacress (Lepidium oleraceum). This is a plant of the turnip family, possessing large thick leaves which is still to be seen on North Otago Head, Pudding Island, Lawyer's Head, etc.

A mealy-leafed succulent with smallish rounded leaves known as Atriplex buchanani grows on Green Island Peninsula, or Black Head, as it is variously named. Round the harbour, on the east side particularly another species of orache (Atriplex patula) may be noted which has much larger, triangular, and less mealy leaves and a somewhat more upright habit of growth. Three native species of fat-hen (Chenopodium) occur, but none are typical cliff plants unless perhaps a trailing form (C. triandrum), a species not unlike the orache.

All the plants named so far are herbaceous. Indeed, there are only two shrubs that are absolutely confined to cliff faces

round the coast, and of these one is the Shore koromiko or Shore speedwell (Veronica elliptica). During the summer months this very handsome shrub produces quite a wealth of white or lavender blossoms which are much admired. Like the Tillaea, it has a wide distribution in the Pacific, and reaches the shores of Chili and Fuegia, being common also on the Auckland and Campbell Islands. Dr Cockayne informs me this shrub will probably be known in future at Hebe elliptica. The second shrub (Helichrysum selago) or Cape Saunders rock daisy, differs from every other form of the same plant found on the Alps and elsewhere to such an extent that botanists are not yet agreed as to its proper name. Its leaves are reduced to scales, causing the shrub to resemble greatly a whipcord veronica, for which it is often mistaken. Cape Saunders and Sandymount are its only known habitats.

Another shrub that grows very freely on the more sheltered rock faces, especially such as have a northerly aspect, as on the Peninsula shore of the harbour, is the akeake (Olearia avicenniaefolia). This shrub daisy has long, pointed leaves and papery bark which peels off in a manner similar to that of manuka or totara.

Amongst the herbaceous plants, the following, in addition to those already alluded to, will be found nowhere else than on shore cliff faces:—The sea-groundsel (Senecio lautus), the native sow thistle (Sonchus asper). Thomson's rock-daisy (Brachycome Thomsoni), native shepherd's purse (Capsella procumbens), a forget-me-not (Myosotis capitata), and two ferns—the shore spleenwort (Asplenium obtusatum) and Bank's hard-fern (Blechnum Banksii, otherwise known as Lomaria Banksii).

The groundsel is everywhere common in suitable localities, as also is the spleenwort. The former is very like a succulent edition of the common garden groundsel with the customary yellow flowers, followed by seed heads resembling those of a sow thistle. The spleenwort has thick, dark green fronds the size of which varies with the degree of shelter available. The spores grow in numerous furrows on the underside of the frond, which always lie at an angle of about 45deg to the midrib. Bank's hardfern is very common on the steep banks above high-water mark from Brighton to Taieri Mouth, especially about Bruce's rocks, and has two kinds of fronds—the foliage frond and a narrower spore-bearing frond.

The sow thistle is very like the introduced plant, but is distinguished by its very mealy leaves. Brachycome Thomsoni is common enough in parts of Stewart Island, but locally it grows only at Black Head. Even there it is far from common. Capsella procumbens, one of the rarest of New Zealand plants, is absolutely confined to the cliffs of the North Otago coast. Not a dozen specimens have yet been seen, but the known localities include Forbury Head and Black Head. Notwithstanding its great rarity here, it is a plant with an exceedingly wide distribution, being known from Europe, Asia, South America, and Australia. From a central tap root it gives off numerous almost prostrate stems, from the upturned tips of which the pods are developed.

The forget-me-not was formerly known from Black Head and Lawyer's Head, in both of which localities it is now extinct, but a few plants still grow at the entrance to Hooper's Inlet beside a very prominent dyke that bisects a large bluff of breccia. This plant differs from the typical form of the species which grows in the Auckland and Campbell Islands in having white instead of blue flowers, and is distinguished as variety albiflora.

A number of plants that may almost always be gathered on these cliff faces are, however, not limited to such localities, and include the following:—The Samolus and Selliera, already referred to, which display quite a wealth of attractive blossom in season; a sweet-scented species of Cotula (C. dioica), everywhere common on the coast; the true native flax (Linum monogynum), representative of the Irish flax from which linen is manufactured; the native iris (Libertia ixioides); species of Pimelia (P. laevigata and P. Lyallii), often mistaken for veronica; various sedges and grasses to be referred to later; and the succulent Tillaea Sieberiana more common on dry cliff faces inland.

IV.—PLANTS OF THE SWAMP AND BOG.

In our district almost every stage in the transition from open expanses of water to what is commonly termed dry land may be met with, and these transitions are amply reflected by the wild plants that clothe them. For our present purpose it will be sufficient to refer to all such marshy stations as "swamps" unless the water is stained brown with peat when the term "bog" is relevant. Bogs are best developed locally on Swampy Hill and on Maungatua while swamps have their greatest development near the mouth of the Kaikorai and at the southern end of the Taieri Plain.

THE PLANTS OF THE SWAMP.

There are something like 65 to 70 typical swamp species in the New Zealand flora, of which almost one-half are found nowhere else. The actual assemblage in an individual swamp apparently depends mostly on the altitude or latitude of the place and on the degree of wetness of the soil. So great, indeed, is the influence of the percentage of soil water

on the vegetation that lakes and lagoons that gradually merge into swamp will as a rule be found to be encircled with distinct zones of vegetation each differently composed. We already have found the same thing round our tidal inlets.

Excluding floating plants, that one which advances furthest into the open water is almost invariably the raupo or bulrush (Typha augustifolia), a plant which in the economy of the Maori provided many useful articles. The pollen was baked into a sort of bread, and even the swollen base of the stem provided sustenance in times of scarcity. The leaves were used for thatch and for the sails for their canoes. The raupo is no longer so common as it formerly was, but small clumps of it are still to be seen in many localities. Even at the head of Otago Harbour, near the engine-cleaning sheds, it may still be seen. The most typical plant of "wet" swamp is the niggerhead or Maori-head (Carex secta), a plant which sends its living roots into the dead fibre derived from the death and decay of the earlier roots, whence it derives adequate supplies of fresh rain-water. Plants as a rule have difficulty in absorbing swamp water, hence the usefulness of the dead stump is at once apparent. Indeed, other plants find these fresh water reservoirs much to their liking, and it is a very common thing to find the common hard-fern (Blechnum capense), a little white violet (Viola Cunninghamii), the bronze-leafed silverweed (Potentilla), a species of clevers (Galium tenuicaule), and even such shrubs as the koromiko (Veronica salicifolia), and the mingi-mingi (Coprosma parviflora) flourishing on the stump of a niggerhead..

Somewhat drier, average conditions lead to a different type of swamp in which rushes and sedges of various sorts are still the dominant types; and still "drier" swamp is usually covered with flax and the graceful toi-toi (Arundo conspicua). Another type is locally well represented in the hollow beyond Alexander's Corner on the road to Brighton, where the introduced celery-leaved buttercup (Ranunculus sceleratus) and the native foxtail grass (Alopecurus geniculatus) occupy the ground almost exclusively. Mingi-mingi swamp is represented by a small patch on the sandspit at the entrance to the harbour, while manuka swamp, so well developed especially in the North Island, is locally represented by small patches only, as, for example, on the sandbar of Hooper's Inlet.

Without further attempt at classifying the various types of swamp we shall note briefly a few of the best-known occupants. The swamp is the typical home of rushes and sedges, of which close on 60 species are to be found locally. The common wi-wi (Juncus effusus) is without question the best-known rush of the swamp. Not all rushes and sedges occur in swamp, however, many growing on the sea coast and hillsides; but, as a chapter will later be devoted to these and to the grasses, we may leave them for the present.

Another genus, the species of which frequent damp situations as a rule, is the Epilobium or willow herb. Willow herbs are botanically related to the fuchsias though showing little outward resemblance to them. The tallest local species are E. pallidiflorum, E. junceum, and a rarer form (E. chionanthum); the flowers of the last-named are large, white, and showy. These three species are erect growing herbs from 18in to 3ft high, nowhere very common in the district. Indeed, E. chionanthum has been seen only on the Opoho Creek bed.

The yellow flowered Silver-weed (Potentilla) with its bronze-coloured foliage cannot possibly be mistaken, while the Gunnera is everywhere abundant. The two local species, in common with all other species of the genus, are invariably associated with a fresh-water alga (Nostoc), as also is the red, floating, water fern (Azolla) to be seen on Tomahawk Lagoon. Gunnera has creeping succulent stems and ovate notched leaves, at the base of which its porcelain white berries grow. In small pools in the swamp and in similar stations the finely divided leaves of a native buttercup (Ranunculus rivularis) may be found floating on the surface, and occasionally, as in pools at the foot of Stony Hill, the imported white-flowered buttercup (R. aquatilis) is to be seen, its submerged leaves reduced to mere threads.

At Whare Flat, on Flagstaff, Swampy Hill, and at Taieri Mouth a native species hitherto unnoted (R. macropus) may be seen in just such situations as one would look for the sweet-scented musk—so-called, for musk the world over seems to have lost its sweet scent in recent years.

A number of water-weeds capable of growing on or in water will usually be found in swampy areas even in the absence of pools of water. Such plants as the duckweeds—Montia and Callitriche, Glossostigma and Lemna, come to mind. Glossostigma has been found in this district only by Mr B. C. Aston, of Wellington, who met with it on the sand flats of Wickliffe Bay. Another rare swamp plant (Tillaea Sinclairii) has been reported only from Tomahawk Lagoon and Swampy Hill. The native nasturtium (N. palustre) is said to have once proved a nuisance in the wheat paddocks of the Taieri Plains, where, however, it is now much less common.

Marsh-pennyworts (Hydrocotyle) and Nerteras (Nertera setulosa and N. repens) are always common ground plants, the former having round leaves, with notched margins, and the latter small entire leaves, and very attractive red, translucent fruits.

As already mentioned, at Hooper's Inlet, on Sandymount, and at Tomahawk Lagoon a small plantain (Plantago triandra) is not uncommon in places. It is, however, not confined to swampy places, though it favours these. This plant, which is usually a mountain species, reaches sea-level at Dunedin.

The little Limosella, a relative of the speedwells, may also be regarded as a swamp plant, though it is usually found near the shore. The fate of three interesting and locally very rare species that grew at the "Maori Grave" before the flood, remains to be seen. These were our Limosella and its relative Gratiola nana, and the Crantzia lineata, a diminutive member of the great family to which the carrot, fennel, aniseed, and parsnip belong.

Most of the plants named so far have some character or characters indicative of drought-resisting powers. This may seem paradoxical in view of the abundance of water in the soil on which they grow, but once again let us remind ourselves that swamp water, like brackish water, is not as a rule easily absorbed by plants. In reality rushes grow on dry hillsides as well as on swamps because the two localities are ecologically similar—that is, they supply approximately equal quantities of water in equal intervals of time.

In considering next a few of the occupants of the bogs we find the drought-resisting characters very greatly intensified. Indeed, some of the plants of the Maungatua bogs have adopted the identical habit and form of the world-famous mountain sheep (Raoulia eximia), which grows on the barren shingle screes of the highest mountains.

PLANTS OF THE BOG.

Almost the whole of the summit of Maungatua at its highest part is composed of peat, in which there are numerous bogs, dry only in prolonged periods of drought. At Christmas they are sometimes almost all dry, but this is a rare occurrence. A majority of the plants growing in these bogs have taken the form in which only the tips of each stem can be seen. These all grow to the same level and are so tightly packed together that it is with great difficulty that one pushes his finger into the cushion that results.

Most conspicuous of these plants are the bright green convex cushions of the Phyllachne Colensoi, especially when in December and January they are studded with their numerous white flowers opening fully only in bright sunshine. Much less conspicuous are two of its close relatives, Oreostylidium and Forstera tenella. The Forstera is common on all our high hills, is not by any means confined to swamp or bog, and is never a cushion plant. On Flagstaff it grows as low down as 1000ft, though it is usually considered an alpine plant. Our plant is not F. Bidwillii, as given in the Field Club catalogue, though it is exceedingly similar.

Closely resembling the Phyllachne is another moss-like cushion-plant regarded by some botanists as belonging to the same family—Donatia novae-zealandia. This plant is common in all our mountain bogs and occurs also in Tasmania, the only other species being found in the south of South America. As is usual in such places Sphagnum moss is met with—sparingly on Maungatua, but in great sheets on Swampy Hill. Growing in it on Maungatua one finds a number of interesting plants. The Creeping Coprosma (Coprosma repens) with its large, erect flowers, conspicuous mainly by reason of the great length of the anthers of the male blossoms, is abundant, though omitted from the catalogue. A small buttercup not known elsewhere locally is Ranunculus gracilipeo. Drosera arcturi one of our two sundews, grows here and on Swampy Hill. This latter plant, like all other flycatchers, secretes a fluid which digests the body of the insect. Thus it obtains the nitrogen it requires—a plant food always difficult for a plant to obtain from the water of a bog. (On Swampy Hill orchids in some variety are the principal occupants of the sphagnum.) Close by grow two species of eyebright or Euphrasia (E. Dyeri and E. Zealandica, the former only on Maungatua. These plants are semi-parasites on the roots of other plants. The first-named is erroneously given as E. repens (a seashore plant) in the catalogue; the latter grows on all hills above 1500ft.

Two sedges forming more or less dense cushions in alpine bogs are species of Oreobolus (O. pumilio and O. strictus). These both occur on Swampy and on Maungatua. Two others externally similar and very closely related are Centrolepis pallida and Gaimardia setacea. In all four the leaves are arranged along the stems somewhat after the manner of the teeth of a comb. A more open grass-like sedge with its leaves frequently white and curled is the Carpha (C. alpina).

On the drier peat areas there are five species of celmisia, better known as the mountain daisy. One of these (C. sessiliflora) is a veritable gem. This, too, is a cushion plant, usually about a foot in diameter, which produces its pure white flowers in great profusion over the whole surface of the cushion. I know no local plant to compare with it in beauty, as it flowers in the Maungatua alpine bogs about Christmas and New Year time. In smaller numbers one meets another silver-leaved variety (Celmisia linearis), with leaves about 3in long, and also a long-leaved variety with yellowish, strict leaves up to a foot in length (Celmisia Lyallii). This

species was named in the first catalogue of local plants compiled for the district, but has since been omitted. Nevertheless it is quite common on Maungatua, whence it was originally reported by Mr S. Fulton. An alpine form of the widely dispersed C. longifolia is abundant, and also the well-known cotton plant, the giant of the genus (C. coriacea). I have measured leaves on Maungatua close on 3ft long; indeed, the local plant is quite a distinct form of the species, and, I think, the biggest Celmisia in existence. Both the last named plants occur at all levels on Maungatua above 1500ft, but Celmisia longifolia alone occurs elsewhere. Formerly on Mihiwaka and also on Flagstaff, according to Mr Henry Matthews, a sixth species (C. densiflora) was found, but this has not been seen now for some time. None of these last three is a typical bog plant, and they would best be considered in another section. The blue-flowered grass-like lily (Herpolirion), sometimes called the grass-lily, is very abundant on the peaty soils of Maungatua and Flagstaff, though it rarely grows on the margins of typical bog. Only on Maungatua is the swamp-pine (Dacrydium Bidwillii) to be found. This diminutive pine fruits when only a foot or more high.

It is difficult to draw a clear distinction between such plants as grow in the bogs and such as frequent the peaty soils of the intervening areas, but those plants not treated of so far will be considered briefly later on.

Before concluding this section reference should again be made to the sphagnum swamp near the road close to the homestead of Mr Allan, of Hooper's Inlet, where a second sundew (Drosera binata) is the most interesting plant. The only locality nearer than Taieri Mouth where this species can be found is in a small bog near the foot of Saddle Hill, where the old quartz battery used to operate.

V.—TREES OF THE FOREST.

In the early days of Dunedin, the hills surrounding the harbour were forest clad to the water's edge. Beyond a strong, local development of one or more of the trees, the composition of this large tract of forest was remarkably uniform, save that certain trees common on the higher levels were missing from the lower. Indeed, five trees may be said to have been almost wholly confined to the bush above the 500 or 600 foot contour.

In strong contrast with the forest of the immediate environs of Dunedin, that at West Taieri might be cited. Here, as in the Maungatua and Waipori forests, the silver birch—so-called, for the tree is a beech (Nothofagus Menziesii)—is the dominant tree, rendered more conspicuous by the enormous clumps of mistletoe which thrive upon its branches. A few specimens of this tree are known from the bush above Ravensbourne.

Nine of our 40 trees are spoken of as pines, though only the cedar bears cones. The red pine, black pine, white pine, yellow pine, the miro, and the two kinds of totara are, in fact, close relatives not of the pine but of the Irish yew-tree and, like it, they bear fleshy, spurious fruits resembling berries in place of cones. The cedar (Libocedrus Bidwillii) is very plentiful in the upper forests of Flagstaff, Swampy, Mount Cargill, and Mihiwaka, and gives a touch to the local scenery suggestive of the great pine forests of the Rocky Mountains. The celery pine (Phyllocladus alpinus) only rarely reaches the dimensions of any of the larger trees, and might have been relegated to the shrubs. Though entirely leafless, its flattened branches could easily be mistaken for leaves; the wood is very ornamental, and in consequence is greatly prized for inlaying, while the bark contains a high percentage of tannin suitable for industrial use.

Rimu, or red pine, is still plentiful at Woodside, the upper Leith Valley, and at Mihiwaka, but the great quantities that were formerly milled in the district have thinned it out to the point of extinction in other parts, notably the Peninsula. Its graceful, drooping branchlets distinguish it from all other local trees.

Miro and black pine are not unlike, both having flattened branchlets, but the larger size both of these and of the fruit at once distinguishes the miro. The branchlets of white pine are not unlike those of the macrocarpa

Both the ordinary totara and Hall's totara are to be met with, the latter being distinguished by the thin, papery bark and, in young specimens, by the large size of the leaves, which may be from one and a-half to two inches long. Some large trees of the true totara may be seen on Saddle Hill, at West Taieri, and on Mihiwaka. The silver pine (Dacrydium Colensoi) has often been reported from Mount Cargill and Mihiwaka, though Dr Petrie assures me that our local plant is the true yellow pine (D. biforme). This latter certainly occurs on Mount Cargill, but further investigation will be made in respect to the former. The two totally distinct types of foliage occurring on one and the same branch constitute the most pronounced feature of the yellow pine.

In point of size, few local trees reach the height or size of these various species of "pine." The pokako (Elaeocarpus Hookerianus), while nowhere in the district an abundant tree, nevertheless reaches a great size. This tree has a very light coloured, round trunk, terminating in a massive, round head of dark green foliage. The flowers closely resemble those of the lily-of-the-valley, while the foliage of the young plant bears not the remotest resemblance to that of the adult. A specimen in the valley of Morrison's Creek, several in Christie's Bush on Saddle Hill, one or two in a tongue of bush projecting on to the Taieri Plain at Woodside, and several not far from Mihiwaka railway station reach very considerable dimensions.

There are several species of kowhai native to New Zealand, the local one being Sophora microphylla. This was once a very common tree on the Peninsula, but the best groves remaining to-day are those at Woodside and at Whare Flat. Some fine specimens also occur in Lower Leith Valley, Bethune's Gully, and on Saddle Hill. Specimens growing on Black Head lie prostrate and develop their flowers only on their lower sides, sometimes as early as the first of June.

The pennantia or kaikomako (Pennantia corymbosa) though widely distributed, is never abundant. The adult leaves are dark green, notched, and glossy. The wood was formerly much prized by the Maoris for obtaining fire by friction. A small tree often confused with it—the milk-tree (Paratrophis)—is unusually common in the Dunedin bush, but in reality the resemblances are fewer than the differences. The popular name of milk-tree is suggested by the milk-white sap which exudes from the cut branches during the spring months. This tree is an arborescent member of the nettle family.

In addition to the shrubby ribbonwood, already referred to as growing on the shores of our tidal inlets, two others are common trees in the neighbourhood—the broad-leafed ribbonwood (Plagianthus betulinus) and the narrow-leafed (Hoheria angustifolia), of both of which good specimens may be seen in the Woodhaugh Gardens. The former is deciduous, and the latter is a most attractive plant in the flowering season.

The ivy family, as in the case of the "pine" family, is represented locally by nine distinct species. Two are known as lancewoods or grass-trees, but this latter name is much more appropriately assigned to the inanga (Dracophyllum longifolium), a tree still common on Mihiwaka and Mount Charles. Both the lancewoods (Pseudopanax) have long, deflexed leaves in young plants, and short, broad leaves in the adult. P. crassifolium is everywhere common, especially on bush margins as on Stony Hill, above Ravensbourne, but the other (P. ferox), though ranging from Ahipara in the north to Croydon Bush near Gore in the south, is nowhere abundant. Locally it is well developed in the bush behind Mr Tannock's house at the Public Gardens. The patate (Schefflera digitata) has as a rule from six to nine leaflets, arranged as in the case of the horsechestnut, and possessing very fine marginal serrations. Though statements have appeared in print stating that this plant was very rare locally, such was never the case, for it always was, and still is, abundant in Bethune's Gully, the middle Leith Valley, and in the bush on the slopes on the north side of the harbour.

The remaining representatives of this family have the generic name Panax, which includes among its foreign representatives the well known ginseng. The five finger (P. arboreum) grows on Mihiwaka and in the Leith Valley, but is very far from common. Another species exceedingly like it, but having as a rule only three leaflets instead of five, is known as P. Colensoi, or more commonly as the Ivy-tree.

Everywhere common above 1000ft is the Panax simplex, or Mountain Ivy-tree. Young plants have three to five much-divided leaflets, though adult trees have but one—whence the name simplex.

This remark is also true of Edgerley's ivy-tree (Panax Edgerleyi) but the leaves are very much larger. Indeed, the adult trees show no resemblance. The raukawa, as the Maoris know it, is common in the bush at Swampy Hill and on Mihiwaka, but individual specimens are common in other parts. From the leaves the Maoris obtained a sweet perfume for anointing their persons.

Last year the writer discovered a variety of Panax simplex, known as var parvum, close to the roadside near Sullivan's Dam, and again this month close to the picnic ground at Woodside. This form has leaves about half an inch long, and fruit in tiny clusters of three and four. The most interesting and curious panax in the district is one well named P. anomalum. It has very small leaves

which, especially in young plants, assume an endless variety of forms. Specimens are known on Black Head and at Sandymount belonging to the variety microphylla, and having exceedingly tortuous, interlacing branches.

A tree common in most parts of New Zealand but very rare locally is the Kamahi (Weinmannia racemosa). A few trees in the upper Leith Valley and one or two on Signal Hill are the only local representatives nearer than Taieri Mouth.

Where the larger timber trees have been cut down, the commonest bush trees are the broadleaf, konini, marble-leaf, tarata, matipo, red maple, wineberry, and whitey-wood. The first named has large, leathery, unserrated leaves, and like its epiphytic representative of northern forests frequently commences life as a seedling, rooting on the stem of a tree-fern. It produces heart-timber of great durability, suitable for fencing posts.

The konini or fuchsia (F. excorticata) is too well known to need description. In Dunedin it is almost completely deciduous, and like many of our spring flowering shrubs, it produces its blossoms before the bursting of the leaves. The blue colour of the pollen and the strong development of chlorophyll in the layers immediately beneath the thin, papery bark are interesting characters. Outside of South America, New Zealand is the only country where fuchsias are to be found. A beautiful tree with mottled green leaves which frequents almost every patch of bush in New Zealand is locally known as the marble-leaf or native may. The Maori name is puta-puta-weta, signifying the tree in which the giant weta or taipo dwells—while to science the tree is universally known as Carpodetus serratus. When, in late summer, it is clothed with its profuse clusters of white blossom, its attractiveness is still further enhanced. This tree is the favourite host plant of the white-berried mistletoe (Tupeia).

The genus Pittosporum has three local representatives—the common black maple or matipo, the tarata or lemonwood, and Colenso's matipo. The tarata is sometimes called the turpentine tree and occasionally the white maple. To science it is Pittosporum eugenioides. The long, crinkly leaves, with a pronounced, yellow midrib easily distinguish this most handsome tree from all others. The common matipo has shorter and broader, crinkly leaves which are green on both surfaces. This serves to distinguish the plant from the Olearia which, like it, is often used as a hedge-plant. Pittosporum Colensoi has larger leaves and thick, woody capsules, those of the common matipo being thin and leathery. Colenso's matipo was thought to be now extinct in this district and accordingly was omitted from the 1916 revision of the Field Club's catalogue, but it still grows on Opoho Hill, at Macandrew's Bay, and on Saddle Hill.

There is another small tree, in appearance so like the matipo that it is often called red maple (the common matipo being black maple, and the tarata the white maple). The word maple is here probably a corruption of the Maori word "mapau" applied to this plant (Rapanea D'Urvillei). It is one of the last trees to disappear from any clump of bush, and partly as a result it becomes frequently the dominant tree, as, for example, near the summit of Signal Hill.

Large thin-leaved plants are conspicuously lacking in our local bush. Hence the wine-berry or makomako, which possesses them is easily recognised. When this tree is covered with its large trusses of pink blossom, as is usual in early summer, it is one of our most attractive plants. Nowhere can it be seen more advantageously than in some of the forest remnants in Anderson's Bay, such as Silver-acres. This tree is known as fireweed in some localities because it is the first plant to reappear after a forest burn. New Zealand currant is yet another name for the Aristotelia racemosa of the botany books. A smaller leafed wineberry was discovered by me last year in a gully half way up Maungatua. It is known as A. Colensoi, and might be regarded as a hybrid between the makomako and the mountain wineberry—a small leafed shrub growing on the summit of Swampy Hill.

The commonest tree in the remnants of bush now scattered over the landscape is without question the whitey-wood (Melicytus ramiflorus) or, in Maori, mahoe or hina-hina. The stems are white and the wood exceedingly brittle. Economically it has now little value save as shelter or even food for stock, though at one time charcoal made from it was prized for the making of gunpowder. The flowers, which grow on the thick stems below the leaves, give rise to beautiful blue berries, so placed as to be conspicuous to the birds by which the distribution of the plant is carried on. Nothing in the appearance of this tree would ever suggest its close kinship to the humble little

violet of our gardens. A narrow-leafed species of mahoe (M. lanceolatus) still grows in the West Taieri district, but it has now disappeared from the more local bush, save for two trees growing naturally in the grounds of Mr W. A. Thomson, of Halfway Bush, who, by the way, is one of the most active students and collectors of our native plants at present living in Dunedin.

One of the trees is the largest specimen known to me. A third species (M. macrophyllus) common enough in the North Island was represented locally by a couple of specimens at Wakari and another at North Otago Head. All appear to have now vanished. A fourth mahoe is represented by a solitary specimen so far as is known, growing at Waverley in the grounds of Mr L. O. Beal, another lover of the native plants.

On Stony Hill, near the mouth of the Kaikorai, there may be seen a small grove of the peach-scented daisy tree (Olearia fragrantissima), a graceful plant of which specimens also occur at the Heads, and on Saddle Hill (two plants only). Another tree daisy of Saddle Hill, Stony Hill and Whare Flat has long, linear leaves and drooping branches, which give the plant a most graceful and attractive appearance. It is well named Olearia lineata. The largest specimen I have seen grows at Whare Flat, and has a stem two feet in circumference.

In suitable places near the sea-coast the ngaio (Kaio) is both common and well known. On holding the leaves up to the light, numerous translucent spots will be seen which are oil glands from which Mr F. M'Dowall has recently extracted an oil, hitherto unknown.

Everyone knows the cabbage tree, but it is to be noted that two purple leaved specimens which formerly grew on Saddle Hill, were propagated and distributed, about 50 years ago. Their removal from another man's property was made the basis of a law-suit at the time. This palm lily was known to the Maoris as the "ti." The plant (Leptospermum ericoides) known to residents as the tea-tree, derived its trivial name from the circumstance of its having been used as a substitute for tea in the early days of the province. The spelling "ti-tree" is, therefore, erroneous where used in reference to this plant, while the appellation "Ti-tri" applied to a small railway siding in the south is a monstrosity indeed.

The tea-tree grows only at low levels, though its close relative, the manuka is to be met with at much higher altitudes. Manuka has its flowers and fruits developed singly, while tea-tree has them in clusters. The latter is the larger plant a specimen in Opoho valley reaching 50ft; manuka rarely exceeds 20ft in height.

In volume 31 of the transactions of the New Zealand Institute, Professor Kirk records a plant of pigeon-wood (Hedycarya) as growing at Port Chalmers, but no one now knows anything about it. The most conspicuous feature of this tree is its fruit which in size and colour resemble those of the well-known supplejack. On the West Coast, it ranges as far south as Milford Sound, but no specimens other than that reported from Port Chalmers, have ever been recorded from districts south of Bank's Peninsula. This completes our list of trees known to exist or to have existed in our neighbourhood.

VI.—THE SHRUBS.

Of a total of approximately one hundred shrubs growing wild in the neighbourhood of Dunedin, fully three-fourths are indigenous to New Zealand. As in the case of the forest trees, so it is true of the shrubs that numbers are restricted either to the lowlands or to a sub-alpine belt. Indeed, the percentage of the total ranging over the whole area is much smaller in the case of the shrubs than it is with the trees, and when it is noted that many shrubs are practically confined to the margin of the bush, others to the open heaths, and still others to the forest floor, or to the sea coast, or to the mountain tops, it will be understood that the task of identifying them is less difficult than might be supposed. For our present purpose, it will be wise to consider the lowlands and uplands separately.

SHRUBS OF THE LOWLANDS.

(A) NATIVE SHRUBS.

Under ths heading, we will include all indigenous shrubs found at lower levels than the upper margin of the forest, and will treat the shrubs in the zone above the forest as sub-alpine. Of the three dozen shrubs which comprise the shrub flora of the lower hills of the district, one dozen belong to the genus Coprosma, and are variously known as karamu, miki-miki, stinkwood, money shrub, etc. These are close relatives of the coffee plant, and of the madder plant which supplied many of the dyes used in commerce before synthetic dyes were introduced. Indeed, on one occasion

"coffee" was supplied for supper, to the members of a New Zealand scientific society, made from the fruits of the Coprosma, while from the roots a number of very brilliant and fast dyes have been prepared. The name karamu is usually applied to the broad-leafed species (Coprosma lucida and C. robusta), both of which are fairly common in the bush—as in the Queen's Drive, or the bush near the Northern Cemetery. A third species with much narrower leaves (C. Cunninghamii), also belonging to the large-leafed group, is common in these same localities.

All Coprosmas have their leaves and their twigs produced in pairs from opposite sides of the stem. The leaves have entire margins and have this peculiarity, that small pits or holes are often developed at the junction of the midrib with the main veins. Even where the pit is not distinct, a marked swelling on the front of the leaf will often be found to indicate its position. The flowers of most species are produced in August and September, but, being wind-pollinated, they share with such plants in general the attribute of being small and inconspicuous. Male or stamen-bearing flowers are not produced on the female or berry-forming plants.

In the bush, the commonest species is C. rotundifolia, which has round, thin, green or bronze-coloured distant leaves and pretty red berries in fruiting specimens. A much smaller species (C. rhamnoides), with smaller and more numerous leaves and numerous tiny bright red "berries" is a shrub worthy of a place in any shrubbery. It is very common on the opposite side of the road from the veronica and celmisia collection in the upper part of the Botanical Gardens.

Another very common Coprosma (C. areolata) has pointed, mottled leaves and a very erect habit of growth, so that it cannot easily be mistaken. Along with C. crassifolia and C. rotundifolia, this mottled species is one of the commonest shrubs near the Fish Hatchery on the Portobello Peninsula. The money shrub (C. crassifolia) is very abundant in all parts of the district at comparatively low altitudes, especially in close proximity to the coast. It has thick, round leaves, and a stiff, rigid habit. Two other species much less common and by no means easy of identification, though closely resembling this last species are C. rubra and C. rigida. The former grows in lower Leith Valley, and the latter on Saddle Hill and at Whare Flat, but neither is by any means confined to these habitats. Being myself none too sure of these two species, I wrote to Dr Petrie, who most graciously supplied authentic specimens gathered in this district, not only of these, but of several other plants of difficult discrimination, and to him my thanks are due.

One of the commonest species of bush margins and in areas of bush from which the taller timber trees have been removed is C. parviflora. This species has, as a rule, very small leaves, the branches have most of the twigs lying in one plane, while the "berries" are blue.

C. virescens, like C. crassifolia, C. rigida and C. rubra, has white or creamy "berries" but is much less common. The best place to find this graceful species is close to the residence of Mr J. Cuff, on Stony Hill, near Kaikorai Mouth, where it reaches the dimensions of a small tree. The leaves are thin and pale yellowish green, whence the name "virescens." Several specimens grow near the fir trees at the end of the track through the Rhododendron Dell, near Mr Tannock's house. Here, too, may be seen the yellow-wood (C. linariifolia) a species only found in bush. The leaves are long and narrow, and the plant frequently reaches the dimensions of a small tree. C. rugosa has already been mentioned as growing at Saddle Hill, Abbotsford, and Look Out Point, and C. acerosa as being a common plant on the sandhills, while four other species belong to the subalpine region. It will thus be seen that there are not fewer than 17 distinct species of this genus growing within a ten-mile radius of Dunedin.

In company with these Coprosmas some of the following shrubs will usually be found:—The pepper-tree, the myrtle, corokia, the melicope, koromiko, native broom, tutu, and young plants of the trees already mentioned, but particularly of the lacebarks, kowhai, carpodetus (puta-puta-weta), milk tree, kaikomako, lancewoods, matipo, and red maple. Climbing and scrambling shrubs and parasites will be considered separately.

The pepper-tree or horopito (Drimys colorata) may always be distinguished from other shrubs resembling it by the bluish colour of the undersurface of the leaf. The name "pepper tree" is given not because of any botanical relationship to the pepper tree of commerce, but merely because the leaves when chewed produce a sensation similar to that produced by pepper. The purplish blotches on the leaves, which are intensified by exposure, make the plant distinctly decorative.

At low levels only one myrtle is as a rule met with locally (Myrtus obcordata). In common with all other members of the blue-gum or rata family, its leaves have entire margins, and the flowers have many anthers; but the deep notch in the top of the leaf is the best distinguishing character. The Corokia is a plant of dry soils, and even of rock crevices. On Flagstaff, at the head of Tomahawk Lagoon, on Goat Island, and on Mount Charles this is a common shrub, but it is quite widely distributed also in other parts of the district.

The under surface of the leaf is white, the flowers and fruit being yellow. The stellate blooms, the zig-zag branches, the white under-surface of the leaves, and the golden berries all contribute much to the attractiveness of this shrub. The orange and lemon family have one local representative in the melicope (M. simplex), but how different are the fruits!—in one case soft and luscious, in the other small, dry and woody. One character alone will serve to identify this shrub. The blade of every leaf has a distinct joint separating it from the leaf-stalk, a character it possesses in common with the orange and other citrus fruit-trees. At Port Chalmers, in Leith Valley, and on the Peninsula in particular, the koromiko (Veronica salicifolia) is specially plentiful. Tutu (Coriaria sarmentosa) is a well-known shrub occasionally confused with tutsan, an important species of St. John's wort, with large yellow flowers, which tutu never has. The poisonous character of the seeds is also well known.

Two species of native broom (Carmichaelia) occur sparingly in the neighbourhood, both being very much alike in appearance. At the Heads, at Whare Flat, at Saddle Hill, and on the hills at West and North Taieri one of the species (C. flagelliformis) is not uncommon. The other (C. subulata) grows on the hills flanking the western side of the Taieri Plain.

On the dry heaths, where manuka is much the commonest shrub, one occasionally meets with the native broom, the mingimingi (Styphelia acerosa), Hymenanthera, tumatukura or Wild Irishman, Cassinia or native box, the everlasting daisy Helichrysum glomeratum, Corokia, the shining-leafed shrub-daisy (Olearia arborescens), and three snowberries (Gaultheria).

Mingi-mingi closely resembles manuka in its general appearance, but the pungent leaf-tips and the red or white berries serve to distinguish it. It is interesting to note that the Chatham Island species (Styphelia robusta) also has red berries on some plants and pure white berries on others. The same thing may be noticed on the snowberries, of which Gaultheria antipoda is the commonest member. The wiry, narrow-leafed snowberry common on Flagstaff is G. perplexa, the third species (G. rupestris) being only occasionally met with, more often at high levels, and having its flowers grouped on a distinct raceme at the ends of the branches, whereas the other species have flowers and leaves growing together on the ends of the shoots. These plants have notched crinkly leaves and white flowers resembling those of heath or lily-of-the-valley.

A very thick stemmed shrub with polished coriaceous leaves is Hymenanthera crassifolia, a shrub in no way suggestive of the violet to which it is botanically related. This grows near the top of Signal Hill, Swampy Hill, on Black Head, on the Cliffs at Anderson's Bay, and on the Taieri River gorge. The berries when ripe are blue and white in clearly defined patches, the blue being produced wherever the berry is exposed to light. The Rev. Alex. Don. of Ophir, has pointed out to me that in Otago Central the ripe fruits often lack the splashes of blue. The Wild Irishman (Discaria toumatou) is best developed locally on the summt of Stony Hill, where it forms quite a thicket. Odd specimens may be found all along the sea cliffs, but nowhere does it reach the dimensions of the scrub growing on the river shingle of many Central Otago rivers—or, at the head of Lake Wakatipu. The presence of spines would in itself suggest the truth that it is a plant which has developed in places subject to long spells of drought. Five species of shrub-daisy grow on the lower parts of the district, including the Cape Saunders Rock-daisy already referred to and the ake-ake (Olearia avicenniæfolia) mentioned as common on coastal cliffs. On the Chain Hills and on all the hills round Dunedin the shining-leafed shrub daisy abounds. It grows in the bush, but more frequently is met with in the open, where it ascends to the hill summits. In early summer its enormous trusses of white daisy flowers make it about the most conspicuous plant of the hillsides. The box or Cassinia has golden yellow stems, and frequently yellow leaves, too, so cannot be mistaken, but a variety with thread-like leaves has once or twice been gathered on Flagstaff close to the reservoir. A small shrub, with round leaves, white below, and rather inconspicuous daisy flowers lacking the usual ray florets, which grows abundantly on the banks bordering the harbour, is met with in scrub over the whole district. Popularly this is the cotton-plant, but scientifically it is Helichrysum glomeratum, so called because it frequently develops large fluffy galls resembling, in a measure, the feathery fruits of the clematis.

Near the sea, the bullibulli or native tomato is very common, especially at Tomahawk. The large, potato-like blue flowers and the subsequent large, yellow, egg-shaped fruits are distinctive features.

The rarest lowland shrubs of the district include a species of mahoe quite unlike the ordinary bush tree better known locally as the whitey-wood (Melicytus ramiflorus). The only specimen known to me grows on the property of Mr L. O. Beal, at Waverley, and rejoices in the name of Melicytus micranthus, though the "small-leafed mahoe" would adequately define it. It might easily be passed over as a coprosma or a young pennantia or milk-tree by a casual observer. A hybrid mapau (Rapanea sp.) growing in some scrub near Kaikai beach was discovered recently by Mr B. C. Aston and Professor A. Wall. The leaves are round and upwards of an inch in diameter.

Two varieties of native box—the Cassinia fulvida variety linearis, already referred to, and Cassinia vauvilliersii, var. rubra—have been gathered on Flagstaff The first one is well known to me, but the second I have not yet seen growing wild. Two varieties of the common manuka also call for mention—the well-known pink manuka (Leptospermum Chapmanii) and a double white, which Mr W. J. Williams informs me was discovered by Mrs Dent (nee Finlayson) on Stony Hill. The first was also discovered on Stony Hill by Mr Justice Chapman, and created quite a stir at the time. When in flower the latter is said by both Mr Williams and the Hon. G. M. Thomson to be absolutely superb.

In the stream beds of Leith Valley and of Saddle Hill and also in the bush on the Town Belt, there formerly grew a few specimens of our only representative of the Verbena family (Teucridium parvifolium). Most of these specimens have gone, and the only plant recently seen in the district is one reported to me by Mr W. A. Bathgate as still growing on Saddle Hill.

The last shrub to which reference will be made in this section is a small-leafed lacebark (Plagianthus cymosus), of which a solitary specimen was known to grow in the garden of the late Captain Russell, of Forth street. This information was communicated to me by Dr Petrie. The plant grew not far from the entrance to the Public Gardens at a spot elevated but little above sea level Another plant at Lyttelton, one at Invercargill, and a small grove near Pelorus Sound were the only other specimens known, till this year I discovered the plant on the Chatham Islands. The fact that it always grows near the sea where P. divaricatus is alone found and always near trees of P. betulinus suggests rather strongly the possibility of a hybrid origin in each case.

INTRODUCED SHRUBS.

It is an anomalous fact that the imported shrubs which have acclimatised themselves to New Zealand conditions should locally be much better known than our world-famous indigenous shrubs. On this account it will suffice if brief reference only be made to such of them as frequent the hills and valleys of this district.

Gorse and broom, lupin and elderberry, may fairly be passed over as known to all. Two species of broom are, however, occasionally met with which cannot be described as common—the white broom (Cytisus albus) and the pale yellow broom (Cytisus candicans). The briar and the dogrose are conspicuous hedgerow plants, the latter being the less abundant. On the Chain Hills, two common exotics are the barberry (Berberis vulgaris) and the hawthorn, which, while a tree rather than a shrub, may conveniently be mentioned here. These and the gooseberry and blackberry are plants, the seeds of which have been scattered by birds. The English tutsan has fairly taken possession of portion of Christie's Bush on Saddle Hill, though elsewhere it is abundant, and, in autumn, a very conspicuous plant on account of its beautiful coloration. Although this plant bears large, bright-yellow flowers, being a species of St. John's wort (Hypericum androsæmum), it is occasionally mistaken for tutu, which has small, inconspicuous flowers arranged on pendulous racemes Both in Christie's Bush and in the Opoho Bush an occasional green-flowered daphne may be observed, while at Anderson's Bay just where the tram turns up the hill, may be seen a much more conspicuous introduction in the tree-mallow (Lavatera arborea).

Few introduced shrubs have as yet become permanent members of subalpine scrub or bush either here or elsewhere in New Zealand; but the Cape Fuchsia (Leycesteria formosa) is now a very common plant in the bush near the Leith Saddle. On Saddle Hill, Chain Hills, and on the lower part of the Peninsula it occurs not uncommonly at lower levels. Its bright green colour, hollow jointed stems, large thin leaves, and purplish "flower tassels" readily distinguish it. It has no affinities at all with the fuchsias as its popular name suggests, being related rather to the elderberry, now so well naturalised as to find itself on the noxious weeds schedule. This completes the list so far as is known to the writer, unless the African boxthorn and the flowering currant may now be regarded as naturalised.

SUB-ALPINE SHRUBS.

Fringing the bush at its upper limits on almost every mountain in New Zealand and separating it from the tussock meadows of the higher sub-alpine levels, there is a belt of shrubs frequently of almost impenetrable density. To such a belt belong the majority of the native shrubs we cultivate in our gardens. Locally this belt is dense, but never impenetrable, thanks to mild climatic conditions, nor is it anywhere very wide. Indeed, in places, as for instance on Maungatua, one can scarcely regard it as a well defined belt at all. If we list the shrubs of this zone, however, and supplement it with such others as grow in the bush only at high levels and such also as invade the meadows well above the zone referred to, we find a considerable number not to be seen at low levels. These we shall therefore proceed to review.

In the forest remnants at elevations exceeding 1000ft the stinkwood (Coprosma foetidissima will usually make its presence

felt even when not seen, should one by any chance happen to break or bruise any of its shoots. It is, however, quite an attractive-looking shrub with larger flowers than are common on other local species of karamu and conspicuous orange fruits. The weeping mapau or, as it is more incorrectly called, the weeping maple (Suttonia divaricata), is another shrub common in such localities as those in which the stinkwood grows, a third being a myrtle (Myrtus pedunculata) which replaces the notch-leafed myrtle (M. obcordata) of the lower levels. Alike on Flagstaff, Swampy, Mount Cargill, and Mihiwaka, and on the higher points of Otago Peninsula these three shrubs are commonly found in association. It is worthy of note, however, that the two myrtles grow side by side at Woodside, where they are the dominant shrubs in the tongue of bush projecting on to the Taieri Plain.

Wherever rock faces occur at high levels one may expect to find a shrub usually named Coprosma cuneata. Dr Petrie, however, points out that this is not the plant figured in the "Flora Antarctica" from the subantarctic Islands, and in this I agree. Dr Petrie thinks that possibly more than one species new to science are at present regarded as C. cuneata, but only the critical examination of large suites of flowering and fruiting specimens can prove or disprove this supposition. C. rhamnoides, C. parviflora, and C. propinqua are also common constituents of subalpine scrub, but I imagine close examination of many of the forms of Coprosma is called for. On Swampy Hill, I have gathered specimens of what one would superficially regard as the same species, some bearing white berries, some cream berries, some crimson, some pink, some almost a brick-red, and lastly some which were white, faintly tinged with blue.

Now in most species the colour of the berry is nearly constant. For instance, C. rhamnoides and C. rotundifolia always have pink to red fruits, C. parviflora and C. acerosa blue, and C. crassifolia or C. virescens white or yellow. Whether, therefore, more than one species or more than two species are included in the above is an unsolved local problem. A very lowly species, little better than a herb, may be gathered near the Maungatua summit bogs—C. repens by name—which has very large upright flowers with prominent stamens or pistil as the case may be, for no coprosma has both stamens and carpels in the same flower or on the same plant. This diminutive plant usually threads its stems through the cushions of the various bog plants, and is not likely to be seen save when in flower or fruit.

On Swampy Hill the dominant shrub on unburnt areas is the so-called native holly (Olearia ilicifolia), a shrub daisy with crinkly notched leaves, stringy bark, and white flowers. Occasionally, but more often in the bush—e.g., at Morrison's Creek—one meets with a few specimens of an allied species having larger leaves with fewer serrations—Olearia macrodonta. A third shrub daisy with even larger leaves (Senecio elægnifolius) used to be much more common formerly than it is to-day, especially on Pine Hill and the neighbourhood of Mount Cargill. With the native holly or at least growing in similar stations, the box-leaved koromiko (Veronica buxifolia) is a very common shrub on Flagstaff and Swampy Hill: on Maungatua it and Cassinia Vauvilliersii—the honey-scented box—are two of the dominant shrubs of the upper 1000ft.

Young grass trees (Dracophyllum longifolium) and manuka are very abundant on areas previously burnt, but no shrubs are here more plentiful than two of the species of snowberry (Gaultheria) already referred to. The commonest one (G. antipoda) has harsh, crinkly, dark green leaves and either white or more commonly dark red fruit.

Heath-like plants succeed the taller shrubs on the upper side and include the common Pimelia. Dr Petrie suggests it may be possible that two such species occur on Flagstaff (Pimelia laevigata and P. Lyallii), but I confess I have neither gathered nor seen the latter in this district. The tiny leaved, wiry stemmed relative known as the Drapetes is well distributed over the upper hillsides of the vicinity, as are Fraser's heath (Styphelia Fraseri), which we mentioned in a previous chapter, and Cyathodes empetrifolia, a dwarf plant with harsh pointed leaves and a small red berry. Of rather rare occurrence is the Pentachondra, a similar shrub with larger fruits and leaves, which latter have a number of conspicuous sub-parallel lines on the light coloured lower surface. Cyathodes pumila, smaller but similar, grows on Maungatua, and has probably been mistaken for the Pentachondra by many of the earlier observers.

Right on the summit of Maungatua no fewer than five species of Dracophyllum are met with, ranging from shrubs several feet in height to drawf shrubs only a couple of inches high. It will be remembered that one of our trees—the grass tree—was a Dracophyllum, now almost confined to the upper bush, though dwarf specimens are not rare on the banks round the shores of the harbour, especially at Portobello. The only other species in the district found anywhere else than at Maungatua is a species of which a few specimens are growing on Swampy Hill just below the trig on the eastern side—D. rosmarinifolium—so-called because of its supposed resemblance to the English rosemary. The

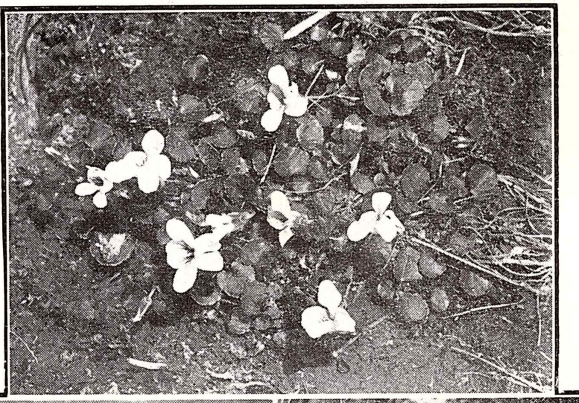
Helichrysum bellidioides (Everlasting Daisy).

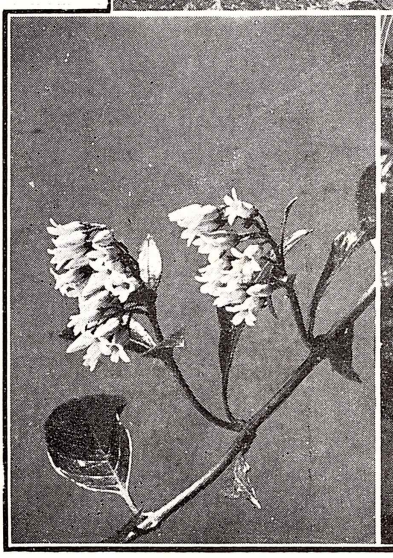
Dracophyllum longifolium (Inanga).

Olearia Ilicifolia (Native Holly).

(Photos by W. Davidson.)

Viola filicaule (Creeping Violet).





Parsonsia heterophylla.

Earina autumnalis
(Grass-leaved Orchid).

(Photos by W. Davidson.)

identity of the Maungatua shrub known as D. Urvilleanum is open to question, as this species is thought to have its southern limit in Nelson.

No other shrubs are common which grow on the hillsides of Dunedin and its neighbourhood, but there still remain a few of considerable interest. Thus the large-leafed wineberry or makomako (Aristotelia racemosa) gives place halfway up Maungatua to a smaller leafed species, A. Colensoi, now reported for the first time. On the summit of Swampy Hill there grow a few scrubby shrubs of a third species, which at times has practically no leaves, though unsually it has a fair number of tiny coriaceous leaves. Large thin leaves are not found in subalpine scrub for very good reasons. The large-leafed tutu of the lowlands gives way to two other species on Swampy Hill, the much smaller-leaved Coriaria thymifolia and the tiny-leaved feathery Coriaria augustifolia. Lastly, two shrubs have been noted on Maungatua which have evaded rediscovery till this autumn when they were seen by Mr J. S. Thomson, viz.—Olearia nummularifolia and Veronica salicornioides. The former of these two name-burdened plants is a thick-leaved shrub found only in localities subject to long drought, while the latter is a whipcord veronica with its leaves reduced to scales and adapted to live in similarly dry localities—usually on arid shingle slopes.

VII.—CLIMBERS, PERCHERS, AND PARASITES.

CLIMBING PLANTS AND SCRAMBLERS.

The numerous lianes, or climbing plants, present in the New Zealand rain forest give it quite a tropical touch. Many of the so-called climbers are, however, to be regarded less as climbers than as scramblers. A true climbing plant always develops some structure or habit which enables it to ascend from the floor to the roof of the forest, while economising in the formation of supporting tissue. Such a plant makes little growth in thickness but rapid growth in length. The recurved prickles of the lawyer, the sensitive leaf-stalks of the clematis, and the myriad stem-roots of the climbing rata enable such plants to commence life deep in the depths of the forest. Scramblers lacking definite climbing organs, such as the pohuehue (Muehlembeckia), must for obvious reasons commence on the forest margin.

Of the various local climbers none can surpass in beauty or charm the beautiful bush clematis (Clematis indivisa), with its ornate sprays of pure lily-white blossom. The flowering season for individual plants is not long, but fully two months elapse from the first blossoms at Waverley to the last on the Leith Saddle or on Mount Cargill. The variations in the size and shape of both foliage and flower in this species are truly remarkable. From the even-edged ternate leaves of the common form every gradation may be found leading to the much-dissected twice ternate leaves of the variety known as var. lobulata, growing an Mihiwaka Saddle. The flowers, too, may have from five to nine pure white sepals (there are no petals on the clematis), varying from very narrow to broad, and pollen either yellow or purple. As male and female blossoms never grow on the same plant, it is obvious that only the pistillate plant can produce the handsome fluffy fruits that follow in the wake of the flowering season. This plant grows easily from seed sown immediately it is ripe, and in sheltered, well drained situations will produce blossoms in the second year.

In the Opoho Bush and on Saddle Hill and Stony Hill a second species (C. fœtida) is quite commonly met with, which has entire margined leaves of variable size, and greenish-yellow flowers. A third species, the leafless clematis (C. afoliata), has for many years been listed among our Dunedin plants as growing at Whare Flat. A reference to the purple flowers of this plant in the logbook of the Field Club strongly supported my belief, based on the grounds of distribution, that the species was in reality C. marata, and a special trip to this locality last Christmas proved the correctness of my supposition. This species is a very slender-stemmed, almost leafless one, bearing purple flowers each with four sepals.

Various species of "lawyer" or bramble are common, but none more so than Rubus australis, the most robust and "tenacious" of the five. The leafless form of another species of lawyer (R cissoides) is abundant in open places, but when growing in the partial shade of the forest margin it loses its leafless character with the development of small leaflets on the tips of what are really the midribs. Only when thus bearing leaflets will it ever be found in flower or fruit. Rubus schmidelioides has long, narrow, green leaves with fewer prickles than other species. The variety coloratus is best distinguished by the white under surface of its leaves, but it is not a common plant. A few specimens grow in the lower valley of the Leith and again on Opoho.

The "lawyer" is not a plant to be expected in deep bush, but when found there it has, as a rule, large dimensions, suggesting that it has grown with the forest, from which its lianes hang. A

specimen near Powder Creek was 5in through, while another large specimen occurs in Riccarton Bush, Christchurch. In the flowering season the lawyer does much to liven up the landscape, being nowhere seen to greater advantage than in Leith Valley or on the Chain Hills.

Two climbers are first cousins of the common periwinkle. One (Parsonia heterophylla) occurs in almost every patch of bush, where its seedlings may be gathered in thousands. The leaves of these seedlings are unusually varied in shape, and have given rise to much philosophical speculation. Of much greater rarity is the pink blossomed P. capsularis. The mature plant of this species has narrow leaves contrasting strongly with the broad leaves of the former. The flowers of both are waxy and sweet-scented, and are followed by long "pods" containing numerous seeds, each furnished with a tuft of hairs after the manner of a thistle "seed."

The climbing lily, better known as the supplejack (Rhipogonum scandens), is still quite common, but nowhere does it now give rise to the impenetrable thickets formerly so common in the Peninsula bush. The bright red berries, though dry and insipid, formed a staple article of diet of pigeons and other bush birds. The small leaved, white-flowered bush convolvulus needs no introduction, but the climbing rata (Metrosideros hypericifolia) is probably less well known, though quite as common. It has fern-like foliage, and white flowers with numerous stamens, and clings tenaciously to the trunks of forest trees by the aid of multitudes of aerial roots. This, together with the myrtle and pohuehue, are the favourite food plants of the stick insect.

It is not well known that we have a climbing or rather a scrambling fuchsia (Fuchsia Colensoi) in our scrub, possibly because it is confused with young plants of the konini or tree fuchsia, which, however, never bear flowers or fruit. This climber is quite common on the lower slopes of Mount Charles, at Hooper's Inlet, and I have seen specimens at Woodhaugh, Opoho, and on the summit road to Portobello. It is unusually abundant at Deep Stream.

The rarest of our climbers is the climbing groundsel (Senecio sciadophilus). This plant formerly grew in the bush on the Queen's Drive, but has long since vanished from this locality. It is now known to me only from Saddle Hill, where specimens were unwittingly gathered by Mrs Harris while procuring seedling clematis for Mr F. Seaton, of Fairfield. An imported Senecio known locally as bush ivy S. mikanioides) has large glossy, dark green leaves, and may be seen in various localities on the Peninsula, notably near Tomahawk Lagoon. The climbing anise (Angelica geniculata) is a common but inconspicuous scrambler of very slender habit, with stems seldom exceeding eight to ten feet, and leaves as broad as long. Along the coastal hills and at Opoho and Maungatua it is not difficult to find. The tendency of the native spinach to adopt a scrambling or climbing habit has already been referred to.

No scrambler, however, is half so common or so conspicuous as the Chinese grape or pohuehue (Muehlenbeckia australis) which festoons the forest margin with a well-nigh impenetrable mantle of greenery. A smaller-leaved species (M. complexa) retains the twining habit but merely twists its own stems into a spiral unattached to any support. It is now a plant of the open, and locally may be seen on the Upper Peninsula road or on the roadsides between Mosgiel and Outram and elsewhere, but it is not at all common.

PERCHING PLANTS.

Besides a number of ferns and lycopods, there are very few plants which habitually take up their abode in the local bush on the trunks and limbs of trees. A variety of seedling plants may, of course, be gathered on tree trunks and fern stumps, where sufficient humus has accumulated to give them root hold, but none of these is restricted to such a habitat. Two (Panax Edgerleyi and P. arboreum) seem to favour the trunk of a tree fern during the first few years till they have been able to throw down roots into the soil, but the only true perchers are species of orchid, a number of filmy and other ferns, a lycopodium, and a plant (Tmesipteris), which has been exhaustively studied by Dr Hoiloway, the recently-appointed lecturer in botany at Otago University.

Earina mucronata is the commonest of the four orchids, and has narrow grass-like leaves and cream coloured sweetly-scented sprays of blossom. Earina suaveolens is a much larger plant, though rarer. Members of the Field Club recently gathered stems over 50 inches in length with terminal sprays of blossom six inches long, in a valley close to Mihiwaka Railway Station. Another magnificent clump in full blossom on a broadleaf on Mihiwaka made a picture not soon to be forgotten. In the same locality Dendrobium Cunninghamii was also seen. This orchid has wiry stems and short grassy leaves, while the purple-centred blossoms are up to three-quarters of an inch in diameter. I have seen this orchid on rocks at Sandymount and Taieri Gorge, and also on the conspicuous rock of breccia overlooking Port Chalmers and close to the Scott monument, while Mrs J. A. Moore has reported it to me from the top of a fallen tree in the valley of Ross Creek, near

the Reservoir. The fourth orchid, Sarchochilus, used to be found near St. Leonards, but has not been recently seen.

THE MISTLETOES.

New Zealand possesses 10 mistletoes, of which five occur near Dunedin. One of these, the scarlet mistletoe (Elytranthe Colensoi), easily takes pride of place as the showiest of the local shrubs. It is almost wholly confined to the silver birch trees growing at Maungatua and West Taieri which at times it literally smothers. Many large beech trees, for such they really are, carry a greater leaf-surface of mistletoe than of beech. When in mid-summer the mistletoe is in full bloom, a trip to West Taieri or Waipori Gorge will well repay any lover of natural beauty. Another large-leafed mistletoe everywhere common throughout the district produces tiny inconspicuous flowers, followed in the case of female plants by yellow, mucilaginous berries. It infests almost every native tree and many introduced ones such as the willow, poplar, elm, wattle, rhododendron, apple, pear, plum, and in particular the hawthorn; but its favourite host plants are several species of Coprosma—rotundifolia, crassifolia, areolata, and parviflora in particular. I have even seen it on tea tree, manuka, and on tetara. Its name is Loranthus micranthus—the small flowered mistletoe.

A third species (Tupeia antarctica) has light-coloured stems, narrow green leaves, and small, round, white berries. Like the last species this attacks almost every native tree in the bush, but its favourite host is the Carpodetus or putaputa-weta, few specimens of which will be found free from the parasite.

The remaining two species are very small and easily missed. One of these formerly called Viscum, but now Korthalsella Lindsayi has many jointed flattened stems from one to 4in long, quite devoid of leaves. Its favourite host plants are the Coprosmas and the red maple and melicope, but I have now secured specimens growing on kowhai, climbing anise, Muhlenbeckia, three species of "lawyer," two species of myrtle, the climbing rata, and on all the shrubby coprosmas, but most interesting of all was to find it growing on a fellow parasite, the Loranthus. At Woodside, Opoho, and Hooper's Inlet I have noted Loranthus parasitised by Tupeia, and at Opoho I have seen Tupeia infested with Loranthus, but instances of such double parasitism are by no means common. In one case I noted the Korthalsella growing on an imported shrub-daisy (Eurybia gunnii), this being the first known instance where this mistletoe has used other than a native plant as its host plant, and all the more remarkable since it has not been known to make a host-plant of any native daisy.

Our last species is a tiny plant burdened with a cumbrous name (Korthalsella salicornioides), which grows only on tea tree and on manuka. The stems are jointed as in the other species, but round instead of flat, and very inconspicuous. The best locality for gathering this mistletoe is on the manuka growing on the top of the banks at Hangman's Gully, beyond the Normanby tram terminus, but it grows on the track leading from Logan's point quarry to the Fever Hospital, and also on manuka overhanging the path on the north side of the reservoir. It is abundant on the roadside near the head of Hooper's Inlet on the south side, and also near Wickliffe Bay.

VIII.—HERBS OF THE FOREST AND HILLTOPS.

HERBACEOUS PLANTS OF THE FOREST.

A herb is usually spoken of as a flowering plant which does not develop woody tissue. The plants indicated by our title will therefore include all soft stemmed plants of the forest other than ferns and their allies. Being few in number and for the most part quite distinct in general aspect, they are not difficult to discriminate.

The largest and most conspicuous herb is the bush-flax (Astelia nervosa), a plant greatly resembling the Phormium, and like it a lily, but having in the proper season a massive central spike of orange berries. Grasses and sedges are plentiful, though the actual number of species is small. The Rice-grass, at once easily the most common and the most conspicuous, may be recognised by the feathery seed-stalks and the broad oat-like leaves, the appearance of which has suggested the scientific name Microlaena avenacea. Equally large, but with stiff wiry stems and much narrower leaves, is the reed-grass (Stipa arundinacea), to be seen in the bush near the Northern Cemetery, near the reservoir, and at Macandrew's Bay. The only other grass really common within the forest is a slender-stemmed species with filamentous leaves known as the slender poa (Poa imbecilla). So far as I know these are the only local grasses to be found nowhere else than "in the bush."

Of the sedges the hooked sedges (Uncinia australis and U. riparia?) are the commonest, the former being a broadleafed, large-headed sedge and the latter narrow leaved and slender. A very tall sedge with hooked seeds, not previously noted in the Dunedin district, but very common at Whare Flat, and known as U. strictissima, though a plant of the open, may perhaps

be justly included in the plants of bush which it invades. Doubtless this very conspicuous rush-like plant has often been seen, and passed over as being the false snow-tussock (Schœnus pauciflorus), which in the distance it closely resembles.

Among the true carices or cutty-grasses, that which is most abundant and widely distributed in the bush is Carex Forsteri, a coarse species with a tall, branched seed-head, but C. dipsacea is fairly common also at low levels.

Of the remaining herbs, the majority are either Nerteras or pennyworts or willow herbs. The Nerteras have entire margined leaves and bright, translucent, pink berries resembling those of the coprosma, with which the nertera is closely related, while the bush pennyworts each have dissected leaves and inconspicuous blossoms and fruits. N. dichondraefolia is found nowhere other than in deep bush, but its two smaller cousins, N. repens and the hair-fringed N. setulosa, are equally common on damp spots in native pasture. The hairy bush-pennywort (Hydrocotyle moschata) and the hairless (H. Americana) are the commonest members of the second group, while the tiny, creeping Epilobium (E. nummularifolium) and two round-leaved, notch-edged species (E. rotundifolium and E. Linnaeoides) are probably the commonest willow herbs.

A hairy, small-flowered bush buttercup (Ranunculus hirtus) is the sole representative of its genus, as is the weak-stemmed prostrate chickweed (Stellaria parviflora). Both are commonest where light has easy access into the bush. The nettle family is represented locally not only by the milk-tree, but by the large, stinging nettle (Urtica ferox) so common on the Portobello Peninsula, and on the St. Clair Cliffs. Urtico incisa is quite a slender nettle occasionally seen for instance near the waterfall in Nicoll's Creek. Here also the Australina is to be found on the wetter soils, while the pellitory (Parietaria debilis) is now apparently confined to the bush remnants on the Peninsula as at Tomahawk and in Mr Barling's bush at Macandrew's Bay. Neither of the two latter plants possesses stinging hairs. The pellitory may be upwards of a foot in height, bearing heart-shaped leaves of very thin texture.

Several species of orchid comprise nearly the balance of the bush herbs. The commonest is the hooded-orchid (Pterostylis Banksii) with a terminal flower one or two inches in length and long grassy leaves. The round-leaved, silver-backed spider orchid (Coryanthes triloba) is scarcely less common, especially on very damp water-sprayed rocks, while a third orchid once common enough in the dampest parts of the bush is now rarely met with. It grows usually on dead logs to a height of one to two feet and invariably looks more dead than alive. By name it is Gastrodia Cunninghamii. A second species not seen since its first discovery by Dr Petrie in manuka scrub near the Northern Cemetery, bears the name of G. minor. Four epiphytic orchids are mentioned elsewhere in this series.

One other herb to which attention is directed is a weak-stemmed plant with three leaflets to each leaf belonging to the Umbelliferae or carrot-tribe. It is not often seen, but I have noted it at Woodside in manuka scrub, near the summit of Signal Hill, and in forest near the summit of Mount Charles. It is appropriately called Azorella trifoliolata, and this name I must use till someone invents a more popular name for it.

SUBALPINE HERBACEOUS PLANTS.

In considering the plants inhabiting the mountain bogs, mention has already been made of many wholly confined to this subalpine habitat; but there are many others. Indeed, it is very difficult to draw any clear line between the plants of the bogs and the occupants of the surrounding peaty soil. Growing on or near the summit of Maungatua the following are common and conspicuous herbs:—The various celmisias and sedges already mentioned, the sundew, eyebrights, the Fostera, the bog-pine, and grass-lily, creeping coprosma and Sinclair's buttercup.

Two species of gentian (Gentiana corymbifera and G. patula), each with large clusters of beautiful white blossoms, cannot fail to attract notice, though the gem of the summit is the cushion celmisia (C. sessiliflora). The Donatia, Phyllachne, Oreostylidium, and Fostera, previously noted, are all closely related plants of considerable beauty either of flower or foliage.

Numerous orchids are here met with, including the Lyperanthus, Chiloglottis cornuta, Pterostylis graminea, and two species of Caladenia, while lower down the beautiful tall, blue-flowered mitre orchid (Thelymitra uniflora), its green-flowered relative, T. longifolia (?), and the smaller onion-leafed Microtis and Prasophyllum are very common species. Of these the Caladenias take first place for the beauty of their flowers, which both here and on Flagstaff are produced in thousands. Indeed, I doubt if any other area in New Zealand could be found with such a wealth of ground orchids as Flagstaff or Maungatua.

A small plantain or rib-grass (Plantago Brownii) may be collected on the summit of Maungatua, an uncommon variety of chickweed with wiry stems and small, sharp-pointed leaves (Stellaria gracilenta), a species of bluebell (Wahlenbergia saxicola), a small astelia with greyish leaves about a foot in length (A. linearis), a reddish

coloured sedge with hooked seeds (Uncinia purpurea), a smaller grasslike plant of the same genus (U. rupestris?), and a white plumed sedge (Carpha) with curled leaves. Dr Petrie regards this uncinia as an undescribed species, and Cheeseman calls it U. riparia, but it has always been known locally as U. rupestris. Two of the less common species of cud-weed (Gnaphalium traversii and G. paludosum), the former with white woolly leaves and the latter with leaves almost devoid of hair on the upper surface, but silvery below are still further plants from Maungatua.

The summit of Flagstaff is one of the few localities where one of our daisies (Brachycome Sinclairii) is to be found, but three similar daisies (species of Lagenophora) likewise occur in this neighbourhood though not exclusively. The Maori onion (Chrysobactron Hookeri) is still very common on the lower slopes, and also on the Chain hills and elsewhere. Near the bushline a few clumps of the mountain foxglove (Ourisia macrophylla) are yet to be seen and admired in season. In damp hollows two forms of clubrush (Eleocharis acuta and E. gracillima), a dwarf sedge (Scirpus aucklandicus) and a buttercup (Ranunculus macropus) are plants to be expected, while the tiny native mint (Mentha) will usually be found on somewhat drier ground. On Swampy Hill many of the above-named plants may also be collected, but one not known to me on the other hills is the small-flowered Avens (Geum parviflorum) which was noted last year for the first time by Miss O. Cartwright, secretary to the Naturalists' Field Club. I had previously got this plant at Whare Flat and in some quantity at Waipori.

A tiny rush (Juncus novae-zealandiae) is in all the above localities very common. Its maximum height seldom exceeds six inches. Two buttercups (R. ternatifolius and R. tenuicaulis) differing from those of all other localities grow on the damp ground near the summit of Swampy Hill. Indeed, it was here that the first plants of the former species were discovered by Dr Petrie.

On Mount Cargill in particular the mountain flax may be very easily obtained, but it is likewise common on the summit rocks of Maungatua. This species (Phormium Cookianum) is distinguished from the common phormium by its smaller size, its yellowish flowers, and its twisted, pendulous capules. The two kinds of Spaniard occurring locally are now much less common than formerly. The broadleafed species (Aciphylla Colensoi) still grows in quantity about the 1500ft level on both Flagstaff and Swampy Hill. In the latter locality plants 10ft high (when in flower) are not altogether rare. The narrow leafed Spaniard (Aciphylla squarrosa) is much less common, but may easily be found on Saddle Hill or on the top of the ridge leading from Logan's Point to the summit of Signal Hill.

The everlasting daisy, while not wholly subalpine, is seldom seen at low levels. It is common in all localities above 1000ft. A very similar plant (Gnaphalium trinerve), which grows always near the coast, is common on banks between Harbour Cone and the Sandymount lime quarry, and may be distinguished from the everlasting daisy in that a cluster of flowers grows on each stem instead of the solitary head in the case of the everlasting.

A yellow flowered daisy (Senecio bellidioides), seldom seen save in subalpine or high level areas, has broad leaves arranged in a rosette, the size of which varies with the degree of shade and exposure. Last week I noted this plant on Corstorphine Hill. It is not uncommon to find specimens on Flagstaff or Signal Hill, with leaves the blades of which are four inches long and three broad! Lastly, there are two strongly scented forms of mountain myrrh (Oreomyrrhis andicola vars. Colensoi and ramosa), which are common on all hill tops, the latter form predominating.

IX.—HERBACEOUS PLANTS OF THE HILL-SIDES.

Under this heading we confine our attention to non-woody plants other than grasses, rushes, sedges, and ferns, such as would be searched for on the open hillside. On all such hillsides, portions of the ground will be found to be habitually damp, though in no sense approaching the wetness of a swamp. Here is the most likely place to search for a dozen or more of our flowering plants, which, however, are far from being the sole occupants.

In such places the two nerteras already mentioned will rarely be missing, while a succulent stemmed, prostrate herb (Gunnera monoica), with broad, deeply-notched leaves and globular, white, black-tipped fruits, will be an almost certain companion. This plant, like its relative (G. flavida), occasionally seen round the Kaikorai Swamp, is interesting, as belonging to a genus that cannot thrive save in association with an alga (Nostoc) which inhabits its cellular tissue. Our commonest buttercup, a dwarf, hairy plant, with several single-flowered stems arising from its centre (Ranunculus multiscapus), is likewise a common member of this association. On the sand spit at the Heads, a form of R. lappaceus, with a single flower-stalk, may be seen. The marsh pennywort (Hydrocotyle asiatica) is wholly confined to such localities as here

described, and may easily be recognised by the spoon shaped leaf tinged with brown. It is widely distributed through the tropics as well as in New Zealand and the Chatham Islands.

Craspedia uniflora is not a constant member in the association we are discussing, but nevertheless is abundant. It is a daisy, with broad velvety strap-shaped leaves, forming a rosette from which rise one or more flower-stalks, each with a globose head of white or yellow florets, such as form the central portion of a dog daisy or summer chrysanthemum. A native plantain (Plantago Raoulii) is specially common at Portobello, Saddle Hill, and North Taieri.

The round-leafed spider-orchid (Corysanthes macrantha) grows luxuriantly near the top of the Stony Ridge Hill leading to Signal Hill, and occurs also on Stony Hill near Kaikorai Mouth, but it may be expected anywhere on damp banks and similar places. A smaller species (C. rotundifolia) grows near the head of North-East Valley, and close to a flax swamp beyond the mouth of the Kaikorai. In similar stations on Flagstaff Pratia angulata, a native lobelia, is not rare. Wiliowherbs of at least six species occur, the grass-like wood-rush, with long hairs sparingly produced on the leaves, and the dark green Colobanthus.

On somewhat drier ground the Maori onion, native mint (Mentha Cunninghamii), various orchids, the long-leafed Celmisia (C. longifolia), the New Zealand daisy (Lagenophora), bitter cress (Cardamine hirsuta), and a scab-weed (Raoulia glabra) are widely distributed. On Flagstaff, and in particular on the lower slopes of Maungatua, the dwarf creeping gentian (Gentiana Grisebachii) with its wealth of white star-like blossoms, is one of the most beautiful herbs. Near Waipori I have seen plants of this species that would have graced the most select garden.

Especially near the margin of bush or along the sea coast, the native iris (Libertia ixioides) will be recognised by its straight, yellowish, flax-like leaves, and large clusters of bright orange or yellow fruits. A large-leafed species was once erroneously reported from the Heads, but the record was based on a false identification, and was corrected in the Otago Witness (August 29, 1895) shortly afterwards. I mention this as the plant is still listed in the Field Club's catalogue. Another plant of similar habit but of much greater rarity is a lily which gives rise to beautiful blue berries gracefully carried at the ends of longish branchlets. This is the turutu of the Maori, the Dianella of the botanist. I have seen it nowhere else than on the Chain Hills and on the hillsides in a valley near Bruce's Rocks, which locality is the only place where I have found the little star-lily (Arthopodium candidum), or the large water-avens (Geum urbanum).

It is abundantly evident that, just as there exists every possible intermediate between the driest and the wettest soils, so the plants that clothe them show every intermediate gradation from the wet soil formations to the dry soil formations. Thus, many of the plants already indicated will be found growing beside those that are named in the following paragraphs. No clear, definite line can be drawn which will restrict the species to one formation or the other. We shall, therefore, proceed by examining some of the plants practically restricted to the driest habitats or at least such as can and do occupy places liable to long-continued periods of drought.

In the tiny yellow-flowered native shamrock (Oxalis corniculata) we have one such. No amount of drought or competition with introduced plants seems to influence either its vigour or its abundance. Then there are the two native species of St. John's wort, diminuuve representatives of their order, one of which (Hypericum japonicum) when full grown has locally rarely more than a single stem 2in high. The other (H. gramineum) is bigger, but diminutive also, having branched stems, somewhat larger, natter leaves, and a decumbent habit of growth. Both have orange-coloured flowers seldom broader than one-third of an inch, and grow usually in association with tussock grasses. Two or three diminutive species of Haloragis, with wiry stems and terminal spikes of inconspicuous flowers, occur very commonly on Signal Hill in particular, where a much-branched daisy of unattractive aspect (Vittadinia australis) may also be most easily procured. This latter plant is widely distributed in Australia and Tasmania as well as in New Zealand. Three species of geranium grow in open dry, grassy places, but Geranium microphyllum is the only one typically developed in such places. The closely related pelargonium (P. australe), or Kopata, is very common on Signal Hill, Saddle Hill, and at Outram Glen. One of the willowherbs (Epilobium pubens) is more often seen on dry, open places than where the ground is damp. The common lovage (Ligusticum aromaticum), though still common, especially on Flagstaff, has apparently been thinned out by the attentions of stock and this is more particularly true of the native anise (Ligusticum gingidium), which, however, is still common on Stony Hill (Signal Hill) and beyond Anderson's Bay. A few plants still grow on the summit of the Green Island hills. The little Dwarf Bedstraw (Asperula) is a very typical square-stemmed plant of the driest stations, yet it is no less common on quite damp soils, and the same remark applies to the New Zealand Bedstraw (Galium umbrosum), so named because it usually grows in the shade of some rock.

SOME LOCAL GROUND ORCHIDS.

(1) Gastrodia minor (x$\frac{1}{4}$); (2) Adenochilus gracilis (x$\frac{1}{2}$); (3) Thelymitra uniflora (x$\frac{1}{3}$); (4) Lyperanthus antarcticus (x$\frac{1}{2}$); (5) Pterostylis Banksii (x$\frac{1}{3}$); (6) Corysanthes macrantha (x$\frac{1}{3}$); (7) Corysanthes rivularis (x$\frac{1}{2}$); (8) Caladenia minor (x$\frac{1}{2}$); (9) Corysanthes triloba (x$\frac{1}{4}$); (10) Pterostylis foliata (x$\frac{1}{3}$); (11) Microtis porrifolia (x$\frac{1}{4}$); (12) Pterostylis australis (x$\frac{1}{4}$); (13) Pterostylis graminea (x$\frac{1}{4}$); (14) Caladenia bifolia (x$\frac{1}{2}$); (15) Chiloglottis cornuta (x$\frac{1}{3}$); (16) Corysanthes rotundifolia (x$\frac{1}{2}$); (17) Pterostylis mutica (x$\frac{1}{3}$); (18) Caladenia minor (19) Prasophyllum Colensoi (x$\frac{1}{3}$).

LEAVES OF SOME LOCAL TREES.

(1) Kaikomako or Pennantia (x$\frac{1}{2}$); (2) Fuchsia (x$\frac{1}{2}$); (3) Totara (x$\frac{1}{2}$); (4) Red maple or mapau (x$\frac{1}{2}$); (5) Pokaka (x$\frac{1}{2}$); (6) Kowhai (x$\frac{1}{3}$); (7) Lancewood or Umbrella tree (x$\frac{1}{2}$); (8) Wineberry or Makomako (x$\frac{1}{3}$); (9) Tarata or Lemonwood (x$\frac{1}{3}$); (10) Matipo (x$\frac{1}{2}$); (11) Narrow-leafed lacebark (x$\frac{1}{2}$); (12) Broad-leafed lacebark or ribbonwood (x$\frac{1}{2}$); (13) Patete or Seven-finger (x$\frac{1}{4}$); (14) Panax or ivy-tree (x$\frac{1}{4}$); (15) Silver birch (x$\frac{1}{3}$); (16) Edgerley's ivy-tree (x$\frac{1}{3}$); (17) Mountain ivy-tree (x$\frac{1}{2}$); (18) Puta-puta-weta or Marble leaf (x$\frac{1}{3}$); (19) Broadleaf (x$\frac{1}{3}$); (20) Ngaio (x$\frac{1}{3}$).

Several cudweeds (Gnaphalium) and scabweeds (Raoulia) occur, but the latter, with the exception of R. glabra, are comparatively rare. R. australis is known only from Sandymount and Mt. Charles and the summit of Mount Cargill, and R. tenui-caulis from Blueskin and Silver Peaks. R. subsericea is met with near Waipori Gorge, on Maungatua, and along the route of the Otago Central railway. The slender everlasting Helichrysum filicaule, with its threadlike stems, folded leaves, and solitary terminal heads, is very plentiful, especially on Signal Hill. Even the Craspedia, mentioned among the damp land plants, occasionally occurs extensively on very dry soils. Other daisies once common, but now rare, are the native dandelion, the slender Microseris, and the very rare (Crepis novae-zealandiae, known only in this neighbourhood from the Chain Hills. The only place in Otago where I have recently seen this last plant is near the foot of Mount Ida.

One of our four forget-me-nots (Myosotis australis) grows in grassy places, as, for example, at the 500ft level on the Portobello side of Harbour Cone. More typical of the dry soil, and particularly that of clay banks, is a creeping herb with horseshoe shaped leaves, related to the convolvulus and known as the Creeping Dichondra (D. repens). Even more typical of the driest soils is a plant (Scleranthus biflorus) which forms yellowish cushions at Tomahawk, near the lagoon, and along the coast towards Black Head. It is, however, not at all uncommon throughout the hilly parts of the district.

The native dock (Rumex flexuosus) has narrow dark purplish leaves and a very much jointed seed stalk which when ripe rots off at its base, and rolling along before the wind scatters its seeds as it goes. It grows, for instance, in the paddocks near Cargill's Castle.

The little white violet (Viola Cunninghamii) is a dainty herb common on the landward side of the sand dunes, and also among tussocks on the hill sides, while a trailing species (Viola filicaule) occurs on Signal Hill and on Mt. Charles.

This completes the list of native flowering plants, so far as my notes indicate, which inhabit the open native pastures and heaths, with the omission, of course, of numerous grasses, rushes, and sedges and of such herbs as have already been mentioned from other locations. A considerable number of introduced weeds have, however, found a place in the vegetation of the hill-sides. Of these the cat's ear (Hypochaeris radicata) is by far the commonest and most widely distributed. This weed has penetrated more deeply into the unexplored regions of the country and to a greater altitude on the mountains than any other introduced plant. It is not our present intention to consider the hundred and fifty naturalised herbs which are to be found in association with the native plants, though mention might be made of several specially interesting species.

Introduced plants can as a rule be recognised as such. We see most of them growing as weeds in our gardens and fields or on our roadsides and railroads. There are, however, a few introductions which lie outside this category. Growing on Flagstaff, not far from the roadside where the track leading to the top branches off from a point beyond the Mental Hospital, there is a species of purple-flowered violet which has been slowly spreading for very many years. It is a native of Southern Europe and Northern Africa. Another plant from this region is a buttercup (Ranunculus parviflorus), which is naturalised on the end of the Portobello Peninsula near the hatchery. The pink and white-flowered form of centaury (Erythroea centaurea) are very common on the hills at Anderson's Bay and on the Chain Hills. The pink form of this bitterleaved gentian (for such it really is) also occurs at Kaikorai Mouth, being much the more common of the two. Two forms of musk—monkey musk (Mimulus luteus) and the scented musk so-called (M. moschatus)—are like the mint (Mentha), watercress (Lepidium), and knot grass (Polygonum persicaria), very common plants by the sides of streams, though none are really hillside plants in any sense.

X.—THE RUSHES, SEDGES, AND GRASSES.

THE RUSHES.

Though quite a small family, the true rushes—species of Juncus—are well distributed over the globe. Of the 16 species indigenous to New Zealand, one half are represented locally, and these are supplemented by many other plants popularly designated rushes, as the wood rushes (Luzula), the twig rushes (Cladium), the spike rushes (Eleocharis), and the bog-rushes (Scirpus).

It is not easy to say in non-scientific language just what a rush is, but the round stems and leaves, and distinct flowers followed by a shining, dark, hard, glossy "seed" are fairly constant features. Sedges have flat leaves forming three rows along the culm or stem, while in grasses the leaves are arranged in two rows.

Rushes usually but not invariably inhabit damp, poorly drained land, and of these the Maori wi-wi (Juncus effusus) is easily the most abundant. The tallest native rush, J. pallidus, grows very sparingly near the base of the Sandspit at Otago Heads.

Locally it is under 5ft in height, but in Stewart Island or on Chatham Islands it may reach to almost twice this height. The nearest approach to this in size is made by J. vaginatus, a densely tufted, stout species almost confined to coastal stations and formerly reported from the Spit. Juncus pauciflorus, though not previously recorded, is common in dry places such as the golf links at St. Clair or the Domain at Brighton and may be recognised from its thin, few flowered stems and laxly tufted habit.

The toad rush (J. bufonius) scarcely resembles any other rush, but is exceedingly abundant on the sides of ditches and even in gardens. In somewhat damper places the flat-leaved J. planifolius may more often be seen bearing a loosely branched panicle of dark "seeded" flowers. J. cæspiticius is met with very sparingly on Opoho Hill near the cemetery, and is best recognised by its leafy habit and by the globose head which crowns the naked flower stalk. Another leafy species of more slender habit, common in many countries of the Northern Hemisphere, has been reported from Sawyers' Bay, but I have not verified this record. Our last species is also least in point of size, seldom exceeding two or three inches in height and bearing one or two shining black nutlets near the top. This plant (J. novae-zealandiæ) is not uncommon on Flagstaff and generally in damp spots at some elevation above sea level.

The wood rush (Luzula campestris) is a plant of almost world-wide distribution and innumerable forms. Locally, two varieties, var. picta and var. australasica occur, which, like all other forms, are grassy plants with leaves fringed with long hairs and terminating in blunt, thickened tips.

The bulrush (Typha) no longer occurs so abundantly as formerly, but in suitable places still finds a home, as at Tomahawk and the head of the harbour. The spike-rushes resemble nothing so much as a spear. Their scientific name of Eleocharis is derived from Gr. "helos," a marsh; and "charo," I rejoice. The common E. acuta grows mostly near the sea, but the much more slender E. Cunninghamii grows near the western summit of Flagstaff, where it has previously been overlooked. Both these and the mud-rushes so-called, are in reality sedges in spite of their popular names.

The jointed rush Leptocarpus is exceedingly abundant in all tidal lagoons round our coastline, and has already received notice.

SEDGES.

These plants include all the well-known cutty-grasses (Carex), which, of course, are in reality not grasses at all, and also the twig-rushes (Cladium), which likewise are not rushes. Perhaps this will serve to show the non-botanical reader how real is the necessity for definite scientific names. Quite a number of alpine and bush sedges have already been referred to—e.g., the cutty grass of the sand-hills, the Carpha and Oreobolus of Maungatua, various hooked sedges (Uncinia), and several species of Carex.

The square-stemmed twig-rush (Cladium Vauthiera) is met with on Flagstaff, Look-out Point roadside, Kaikorai Mouth, and many other places, while its round-stemmed congener (C. glomeratum) is to be found on Signal Hill and on Flagstaff.

The false snow tussock (Schoenus pauciflorus) is known to me only from Maungatua, a patch of what I had formerly regarded as such at Whare Flat having proved on investigation to be a tall, rush-like, hooked sedge Uncinia strictissima not formerly known from this neighbourhood. very wiry, erect, and slender relative, S. nitens, with a small few-seeded head, has been noted at the Heads, where it seldom exceeds 6in in height.

Seven species of Scirpus occur ranging from the large Scirpus maritimus with its thick triangular stems, grassy leaves, and large brown spikelets to the diminutive S. cernuus, one of the commonest plants near the base of coastal cliffs and banks. S. aucklandicus and S. inundatus are very similar fresh water representatives of Swampy Hill and Maungatua, while S. nodosus is a tall, harsh, rush-like representative commonest on the sand hills. Growing in salt water in coastal lagoons one quite frequently meets with another form S. Americanus, which has green, conspicuously triangular stems and a single spikelet an inch or two from the top. This plant ranges over Europe, North and South America, and Australia as well as over New Zealand.

Of the hooked uncinias several have already been mentioned. An exceedingly slender species on Maungatua, and, I think, on Mount Cargill, is well named Uncinia filiformis, and two others, with strongly-tinted stems and leaves, confined to the open country above the bushline, are appropriately named U. rubra and U. purpurata. A species with long slender seed stalks and long narrow leaves occurs in scrub on Signal Hill and elsewhere, known as U. leptostachya, and greatly resembles a sedge growing commonly in the bush, U. riparia. The coarse U. australis is, however, much the commonest species of the bush, as is the dwarf grasslike U. rupestris? on the hill tops.

The true Carex has some twenty or more representatives. Some are common; some are rare; most are difficult of discrimination. The tall, coarse-growing C. Forsteri will almost invariably be found in bush, and cannot be mistaken. Similarly in the swamps Carex secta, the well-known Maori head, and two similar species, C. appressa and C. virgata, with very long,

slender knife-edged seed-stalks, are everywhere common. On Cargill's Cliffs and near the fort at St. Kilda, a very coarse large-headed form is to be found which is known as C. trifida. The "large-seeded," creeping sand sedge previously noted (C. pumila) cannot be confused with any other. One of the commonest sedges (C. ternaria) is a tall, grassy plant, with numerous pendulous cylindrical spikelets, each about an inch to an inch and a-half in length. This will be found in any habitually damp spot. A very common plant, but easily overlooked on account of its diminutive size and grasslike appearance, grows on most of our hillsides, notably at Whare Flat, Saddle Hill, and Signal Hill. It is very aptly termed C. brevicalmis because its seed stalks are seldom much more than an inch long. In strong contrast to this is C. lucida, a narrow-leafed species with seed stalks lengthening in some cases to nine and ten feet as I have noted at Whare Flat, and on Pudding Island, where I got one stalk 14½ft in length.

In bogs bordering the Kaikorai Swamp a very distinct yellowish-green sedge with compact clusters of pale, sharply tapering spikelets is still to be seen, which till recently was believed to be identical with the European C. flava. Dr Petrie has pointed out to me that this is now generally recognised by the lengthy name of C. oederi var. catarractae. Here and there round the harbour a lax tussock-like sedge may sometimes be seen, which elsewhere in the area we have been examining is known to me only from Brighton, where it is quite uncommon. Its restricted, coastal habitat has earned for it the name of C. litorosa. On the damper parts of the top thousand feet of Maungatua occur dense areas of an exceedingly variable sedge known as C. Gaudichaudiana, which is very susceptible to attack by a black smut. On the lower slopes and on the hills from there to Whare Flat a small sedge, C. Colensoi, with a threadlike seed-stalk six to twelve inches long bearing a compact cluster of spiklets at or near the tip, may be gathered without difficulty, likewise a somewhat similar but paler and more grassy species, C. inversa, which, as a rule, has erect seed-stalks in place of the drooping or procumbent stalks of the former one.

A common laxly-tufted sedge with slender culms which frequently elongate to several feet, and known as C. testacea, is best distinguished from C. lucida, which has the same habit, by the more closely aggregated spikelets, of which only one is a male spikelet, whereas there may be one, two, or three such in the other. In this connection it may be well to state that in all the above sedges the very narrow spikelets, or portions of spikelets, are male, and the broader seed-producing spikelets, or portions of spikelets, are female.

Still another carex, with broad, flat, or deeply-grooved leaves met with sparingly in Leith Valley is Carex dissita. The culms or flower-stems are smooth, slender, and leafy, and, as with C. testacea, there is seldom more than a single male spikelet.

A pink tinted Carex with whitish spikelets and quite distinct from any other local sedge is reported from Lake Waihola, but I have not searched for it, so cannot say whether it still grows there or not. Its name is C. Buchanani. At Waipori I found C. pseudo-cyperus, a tall, very distinct looking sedge till then reported only from Otago Heads, where I have not seen it.

THE GRASSES.

Between 40 and 50 native grasses have been collected around Dunedin, while the naturalised grasses now growing beyond the confines of our cultivated fields number almost as many. The forest grasses have been noted, and the introduced grasses we shall ignore.

The tallest and most conspicuous grasses are species of snow-grass (Danthonia) and the toitoi (Arundo). On Flagstaff and other high hills both the giant tussocks (D. Cunninghamii and D. Raoulii) are to be seen in some quantity while on the western slopes of Flagstaff D. Buchanani var. tenuis is now reported for the first time. Its discovery was made by Dr Petrie, who is recognised as New Zealand's leading exponent of the native grasses and sedges. Even commoner species of this genus are D. semiannularis and D. pilosa, the former growing everywhere, the latter most easily got from Signal Hill.

Poas are represented by the common silver tussock and the blue tussock (P. colensoi). A shore-loving species formerly thought to be Poa litorosa but now known to be Poa Astoni, is common at Brighton and at Anderson's Bay. P. pusilla, P. anceps, and P. Lindsayi are all hillside local species.

Fescues have two local representatives—a coarse species from the sand hills Festuca littoralis and an abundant species on the higher levels, F. novæ-zealandica (not F. rubra as given in the Field Club Catalogue). The bent grasses (Agrostis and Deyeuxia) have eight representatives—one growing on coastal stations (D. Billardieri) and having broad leaves and a large feathery flower-stalk, while the others are distributed over the hillsides. Agrostis parviflora is said to be restricted to the western side of Opoho Valley; A. muscosa, a moss-like species, to Maungatua summit; and A. Petriei to Swampy Hill. Other local species are A. Dyeri, the commonest of all, Deyenxia Forsteri, D. avenoides, and D. quadriseta.

Trisetum antarcticum is a tall graceful grass occuring near the entrance to Hooper's Inlet, while the plume grass Dichelachne crinata and the wheat grass Agropyrum scabrum, sometimes termed the blue-grass, are exceedingly common in dry stations. The holy-grass Hierochloe redolens is a plentiful, broad-leaved, sweet-scented grass very common along the seacoast and in damp spots on the hills. High up on Swampy and Maungatua a similar but smaller species, H. Fraseri, replaces it.

The bearded bristle-grass (Echinopogon ovatus) is a grass of the scrub or shade with a compact, pointed or rounded bristly seed-top under an inch in length. Two species of Deschampsia, one (D. caespitosa) of open but boggy land and the other (D. tenella) always to be found in bush as at Morrison's Creek or at the head of Leith Saddle, are by no means common. A peculiar but small, worthless grass (Triodia australis) found on the summit of Maungatua and on the western slope of Flagstaff near the summit is far from easy to find. Much more common is the native sweet-grass, Atropis stricta, so plentiful on the Tainui flats and similar places; while a widely distributed grass, ranging from the sandhills to the middle slopes of Maungatua, is known as Kœleria Kurtzii.

An inconspicuous though tall-stemmed grass by no means common now (Asperella gracilis) is nearly always found near the bush margin; while the native foxtail (Alopecurus geniculatus), already referred to, is rapidly spreading in suitable swampy localities. Lastly, two relatives of the bush rice-grass (Microlæna stipoides and M. polynoda) are represented by odd specimens growing in the bush on the Town Belt and on Signal Hill.

XI.—THE FERNS.

The ferns and fern-like plants of Dunedin number seventy-five; the mosses, numbering several hundreds, have hitherto neither been listed nor counted. Ferns, mosses, lichens, liverworts, and algae are more lowly in organisation than the flowering plants we have been considering and are propagated by spores in place of seed.

Our largest group of ferns is that which comprises the filmy ferns, locally represented by eighteen of New Zealand's twenty-seven species. These beautifully delicate plants have leaves or fronds but a single cell thick, and can thrive in most cases only where the air is nearly saturated with moisture, as in the interior of the densest forest. Some, it is true, are rarely found in bush, and on Rangitoto one—the kidney fern—actually grows on rocks exposed to the fiercest summer sun. All absorb moisture directly from the air mainly by means of their fronds, which, of course, higher plants usually do by means of their roots

A few are, as a rule, confined to the stems of tree ferns; others grow on the limbs of trees, or on rocks, or the forest floor, while one, Hymenophyllum Malingii, is wholly confined to the trunks of the native cedar and totara, though very rarely the latter. Of the first group the commonest is the bristle-fern (Trichomanes venosum), a small species with ribbon-like leaves and leaf segments. On the base of almost any tree fern growing in damp bush or near the bank of a stream, this fern is almost sure to be found. Another small species with broader fronds (Hymenophyllum rarum) is much more common than its name suggests, and grows as a rule higher up the trunk of the tree fern than the bristle-fern, but whereas the former is restricted to the tree fern the latter is not. H. flabellatum is almost equally common, and like it, grows just as frequently on other trees as on the tree fern. Its name, when translated, means the fan-shaped, thin-leaved fern, which is quite an appropriate title.

The largest of the filmy ferns are H. sanguinolentum, H. dilitatum, H. demissum, H. pulcherrimum, and H. bivalve. Locally the fronds seldom reach a foot in length or half that breadth, though in Westland fronds of the same species may on occasion be several feet long. The first-named derives its descriptive distinguishing name from the circumstance that fronds pressed between the leaves of a book when dry stain the paper red or rust-coloured. The second species is now confined to dense bush at high levels, as on Mihiwaka and Signal Hill, and to a few bush remnants near Pukehiki, on the Peninsula. H. demissum is one of the very commonest, and frequently carpets large areas of the forest floor, which the next one never does. H. pulcherrimum grows in single tufts, and has a broad wing on either side of the "stem of its leaf." These will be found either on the ground or more usually on a tree trunk near the base. H. bivalve is a very common draping of the limbs of trees

A very much crimped species, with a crinkly wing on the leaf stalk, has been reported from Flagstaff and from Mount Cargill, but I have not met anyone who can authenticate this statement. I refer to H. australe. A very similar species, if, indeed, it is not in reality a form of the same plant known as H. atrovirens, has for some time been known only from a single spot on Morrison's Creek, but I have noted it lately at Powder Creek, at Whare Flat, and also on the bank of a

stream flowing through the bush at Woodside. Curiously enough, our rarest fern—Colenso's bristle-fern (Trichomanes Colensoi)—grows at identically the same spot at Morrison's Creek as H. atrovirens, while close to it at Woodside I found the Tunbridge fern (H. tunbridgense), so named after its English habitat, for it is a world-ranging species. On Flagstaff and in the valley of Ross Creek, H. peltatum, which is probably a form of the Tunbridge fern, is seen even more commonly.

H. scabrum is now very scarce, and likewise H. ferrugineum, formerly known from Pine Hill and from Sawyers' Bay, but last seen in 1895. On the other hand, H. multifidum is very common both in the upper bush and in rock crevices on Flagstaff and Maungatua, where it ranges right to the summit.

Our last species, H. villosum, though very common, has apparently been overlooked till this year, when the Rev. Dr Holloway, the foremost student of this group of ferns, found it to be one of the most abundant on Mount Cargill. Without question it has been confused with H. multifidum.

Coming next to the tree-ferns, of which we have five kinds, the commonest by far are the slender-stemmed harsh-leafed Dicksonia squarrosa and the thick-stemmed soft-leaved Hemitelia. The silver tree-fern is common on the northern side of the harbour, and formerly was equally so on Pine Hill and on the Peninsula. The fourth species always has a prostrate stem and might well be passed over as belonging to some other type, but on Flagstaff, in particular, and also on most hillsides of the district with a southerly aspect (other than Chain Hills), it is common enough. Because of its shade-loving propensities it is known as Alsophila Colensoi. The silver tree-fern Cyathea dealbata, still common enough on the hills round the harbour and in Leith Valley, cannot be mistaken from the silver colour of the lower surface of its fronds. The fifth tree-fern appears to have been known locally only from Fraser's Gully, but I recently noted it at West Taieri in the patch of bush which extends out on to the Taieri Plain. By name it is Dicksonia fibrosa, so called in reference to its stout, fibrous trunk. It may be distinguished from the somewhat similar Hemitelia by the harshness of its leaf texture.

One of the most beautiful of our ferns (Leptolepia novæ-zealandiæ)—the local representative of the well-known hare's-foot fern—is well distributed over the district though it is never abundant. For some strange reason it has occasionally been described as a very rare fern locally, but such was never a fact. I have seen it on the Peninsula, Chain Hills (in the bush near the mouth of the tunnel), Leith Valley, Morrison's Creek, Nichol's Creek, and in numerous localities on Mount Cargill, Signal Hill, and northern side of the harbour generally, as well as at West Taieri.

The maiden hair fern (Adiantum affine) is perhaps less common now than formerly, but on Mount Charles, on the cliffs near Blueskin Bay, and on the rock faces near the Brighton creamery, it may yet be seen in plenty.

The genus Lomaria or Blechnum, as it is now generally recognised, is locally represented by eight species and may be recognised by the fact that it produces two kinds of frond—the foliage and the spore-bearing fronds. Much the commonest form abundant on the open hillsides or in light bush as at Maungatua is the hard-fern (Blechnum capense). The more correct epithet for these ferns would be "hard-ferns," as many can be transplanted with ease and grown successfully. By the sides of streams, especially in bush, B. lanceolatum and B. fluviatile are much the commonest hard ferns,—the first with pointed leaf segments and the latter with round leaf segments. A species very common at Whare Flat and not uncommon in Leith Valley and Fraser's Gully is B. vulcanicum, a fern very like B. capense, but distinguished by its more pointed fronds and by the lowest pair of leaf-segments which point downwards. A very large erect-growing species, commonest at the higher levels in bush, is B. discolor, which is indeed very like a giant form of B. lanceolatum. The smallest species is B. penna-marinum, or what used to be given the more euphonious name of Lomaria alpina. This is commonest on grassy hillsides, though growing at times on the floor of the forest.

Another species confined to very damp forest (B. Patersoni) has very large, deeply divided dark green fronds, and may be seen in any suitable locality—e.g., Nicholl's Creek, near the gorge, a couple of hundred yards from the Leith Valley road. Still another species B. durum was once reported from Sea View by Mr A. Purdie, but has not been seen in the district for many years; a smaller and more prostrate species, B. Banksii, which is confined to coastal banks, is very common near Bruce's Rocks, and occurs at Anderson's Bay on the north side.

Our next genus with an equal number of representatives is Asplenium, the name applied to all the Spleenworts. In every piece of bush in New Zealand the hen-and-chicken fern (A. bulbiferum) may be confidently looked for, while a drooping species almost confined to limbs of trees (A. flaccidum) is frequently little less common.

Where the ground is drier and light can penetrate the bush A. Hookerianum, the

smallest species other than the next, may be expected. It is very common at Mount Charles, in Mr Barling's bush at Macandrew's Bay, on Saddle Hill, and the Chain Hills, as well as at Whare Flat and Maungatua. A flabellifolium is a trailing plant with thread-like stems and numerous pairs of leaflets. Frequently a bud develops at the tip of the frond from which a new plant arises. At Powder Creek a remarkable example with this second plant producing still other plants at the tips of its own fronds, and these in turn repeating the process, was recently discovered.

On Goat Island, near Portobello, A. adiantoides may still be gathered, though it does not now grow anywhere else in the district.

On all coastal rock faces a very thick leafed species, A. obtusatum, is common—as at Black Head or Forbury Head or Lawyer's Head—while in less exposed situations along the coast a similar plant with divided leaf segments—evidently a form of A. Lyallii—is equally abundant. The shining spleenwort, A. lucidum, grows on Pudding Island and on Goat Island in the harbour, together with forms of A. Lyallii. At Whare Flat A. Richardi is not altogether uncommon. All of these spleenworts may be recognised at once when in spore, for the spore-capsules are packed into slits on the back of the frond placed at an approximate angle of 45deg to the midrib.

Three shield-ferns are common. The first is a tall growing plant with very shaggy leaf stalks and midribs. Occasionally it forms a miniature trunk. The old name is Aspidium aculeatum, the new one Polystichum vestitum. The second plant has a leaf of darkest green—almost black in fact—and like all shield ferns has its spore capsules clustered under little round shields or umbrellas on the back of the frond. This is P. Richardi. A. adiantiforme is a climbing species almost always found on the trunk of a tree fern and not easily confused with any other. Specimens may be noted in Morrison's Creek, at Portobello and at Macandrews.

Similar ferns with kidney-shaped shields, formerly known by the name Nephrodium, are represented by at least three, if not four species. One species, with rough, hairy stems, is on that account known as Dryopteris hispida; another with smooth leaf stalks is D. glabella; a third, not seen locally for years and restricted to New Zealand, has a velvety stem, and is called D. velutina.

D. decomposita is said in the catalogue to be common in bush, but I cannot say that I find it so.

Brackens have three species—the common bracken, the bush-bracken, Histiopteris incisa, abundant on Mount Cargill and most bush margins elsewhere, and the pig-fern or lace-fern, Pteris scaberula, a graceful plant of open spaces in damp localities.

On the slopes of Flagstaff and elsewhere two very similar deciduous ferns abound—Hypolepis millefolium and H. tenuifolia, though the latter is more common on the Pine Hill-Mount Cargill ridge. A third, Hypolepis (H. distans) formerly grew at the head of Tomahawk Lagoon, but was thought to have vanished from the district till Mr S. Earland last year showed me specimens from the Silver Peaks. I also found it this year at Woodside. On Harbour Cone and in the bush near the Gardens grows a dark-leafed fern, Pellaea rotundifolia, with numerous rounded leaflets at intervals along the midrib. While not altogether common elsewhere, it is quite frequently seen, always where the soil is dry. In collections I have seen specimens from Dunedin with more pointed leaflets quite erroeously labelled P. falcata, which does not grow south of Nelson. A very interesting fern (Cheilanthes Sieberi) living only in the very driest of situations, still grows on the cliffs on the south side of Anderson's Bay. The Hon. G. M. Thomson, in his Naturalists' Calendar, regretfully numbers it as a thing of the past, but a few plants still persist in this its only known local habitat.

Six polypodies, two todeas, an umbrella fern, a moonwort, and the adder's tongue fern complete the list. At high levels on rocks and trees the tiny Polypodium australe (old name), and the equally coriaceous P. grammitidis abound, as does the common creeping polypody P. diversifolium in the bush at lower levels. Another tall species, growing only in stream beds in the bush—e.g., on Mount Charles—is now becoming comparatively rare. This is P. pennigerum. Another kind known as Polypodium punctatum resembling some form of bracken frequents the margins and open spaces of bush—e.g., Mount Cargill, while a round or strap-leafed species of very thick texture is particularly common on certain tree trunks. It is very fond of broadleaf and macrocarpa stems and rock faces and owns the descriptive title of Cyclophorus serpens. Like the shield ferns, polypodies have the spore-capsules grouped in round clusters on the back of the frond, but they have no "shield" to protect them.

About 1878 Mr F. Smith, while engaged on the survey of the water race at Whare Flat, chanced on a clump of umbrella fern, Gleichenia Cunninghamii, which till this month was the only clump known in the whole Dunedin district. It now occupies less than a square yard and is very sickly in appearance. Miss Mackay has just reported a second patch from the "Chalkies" overlooking Whare Flat. In the early days a clump in Nichol's Creek and another

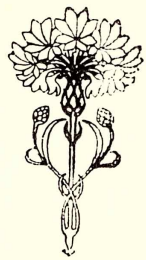
in Morrison's Creek were also known, but these have been destroyed by visitors to these delightful spots.

The tiny adder's tongue, Ophioglossum vulgatum, though still common on Flagstaff and Maungatua, is hard to locate. It grows out in the open grassland. The moon wort (Botrychium ternatum) I have not seen lately, but it used to be common. By many it was known as the carrot fern because of a fancied resemblance seen in the foliage. It appears to have been last seen in 1915 near Mr Ben Rudd's road on Mt. Flagstaff.

The water fern Azolla rubra is abundant on Tomahawk Lagoon, large areas of which are on occasion obscured by its red fronds. It differs from true ferns in producing two kinds of spores. Club mosses or lycopods are represented by at least five species. The long trailing species growing from the branches of trees in the bush is Lycopodium Billardieri. A very similar erect species, growing on rocks on Mihiwaka and Maungatua, is known as L. varium, while on Flagstaff and Swampy Hill, etc., L. fastigiatum, L. scariosum, and the climbing L. volubile are exceedingly abundant. Our last plant is one which like the tuatara, appears to be a living fossil without relatives in the world. It grows on the trunks of tree ferns, where it may easily be identified by its unbranched stems up to a foot in length and thick, triangular pointed leaves. This plant has recently been minutely studied and described by Dr Holloway, who as already stated is our foremost authority on many of the plants mentioned in this chapter.

Conclusion.

In conclusion it may be stated that one result of some three and a-half years' fairly close study of the local florula has been to considerably augment the previously existing list of plants. Indeed, when supplemented by authentic records published by others, but omitted from the Field Club's catalogue, this list exceeds 50. On the other hand a number of the records given in the catalogue have been shown to be based on erroneous identifications. The writer takes full responsibility for all records made herein unless otherwise indicated. It is my pleasant duty once again to acknowledge the help received, in particular from Dr Petrie, but also from Hon. G. M. Thomson, and several others. I trust the record may not be without value to future students. To anyone in search of health of body, mind, or spirit, I commend the study of the great out-of-doors.



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